The Welding Engineer

Reg. U. S. Pat. Office

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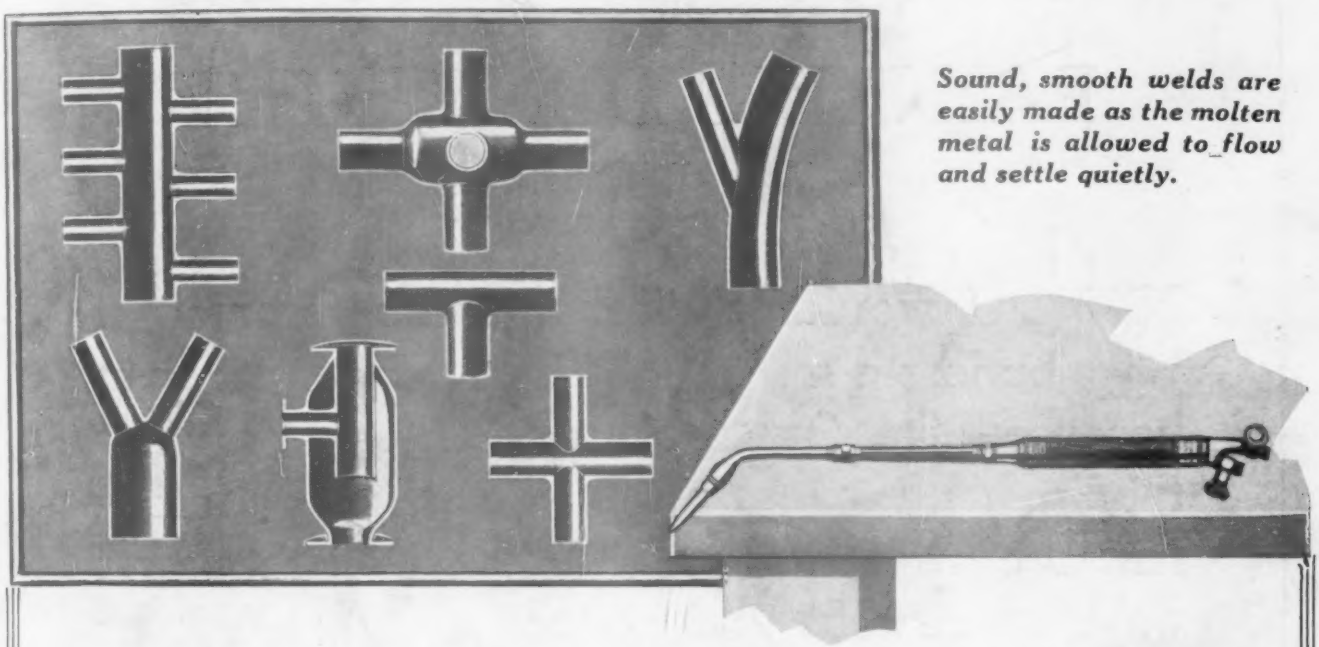

Sound, smooth welds are easily made as the molten metal is allowed to flow and settle quietly.

The Oxy-Acetylene process is now recognized as indispensable for a daily increasing number of manufacturing operations. By welding the parts joined they are made into solid, leak-free, mechanically perfect articles far superior to corresponding articles made by older methods.

Some designers are still clinging to old expensive, impractical and costly methods; the up-to-date man investigates the proper welding constructions and the best welding apparatus in order to do more and better work in less time and at less cost.

TORCHWELD apparatus are well worth investigating. They have done wonders for other manufacturers—they will do it for you, if given the chance.

Write for our new booklet; it will tell you the reason why.

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High Grade Welding and Cutting Apparatus. Portable or Generator Outfits. Welding Rods, Welding Fluxes, Supplies and Accessories.

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It is unexcelled for preheating gray iron, steel, aluminum, bronze or brass castings.

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"Pioneers in the Manufacture of Welding Supplies."
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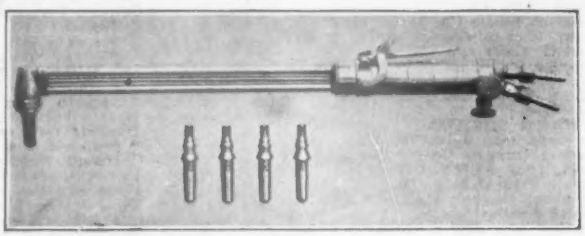

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Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Commercial Acetylene Welding Co.
Universal Oxygen Co.
Prest-O-Lite Co.

ACETYLENE (Dissolved)
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Linde Air Products Co.

ACETYLENE CYLINDERS

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Smith's Inventions, Inc.
The Alexander Milburn Co.
Torchweld Equipment Co.

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The Welding Engineer

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Universal Oxygen Co.

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Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

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Davis-Bournonville
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Davis-Bournonville welding rods are made of special steel that conforms to rigid specification, the result of years of welding practice. D-B rods are carefully inspected and put up in labeled packages convenient to store and use.

Davis-Bournonville cast iron welding sticks are made in a foundry that devotes special attention to the production of cast iron free from fins, sand and blowholes, and which complies with the specification that experience has demonstrated to produce the best results in cast iron welding. If you use D-B cast iron sticks you need apprehend no trouble from hard spots in the welds.

Davis-Bournonville welding materials may cost more but they are worth more.

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Swift & Co.
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Prest-O-Lite Co.
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The Imperial Brass Mfg. Co.
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Universal Oxygen Co.
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Burdett Oxygen Co.
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See also "Torches."
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Burdett Oxygen Co.
The Imperial Brass Mfg. Co.
Chicago Eye Shield Co.
International Oxygen Co.
Torchweld Equipment Co.
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Burdett Oxygen Co.
International Oxygen Co.
Universal Oxygen Co.
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The Imperial Brass Mfg. Co.
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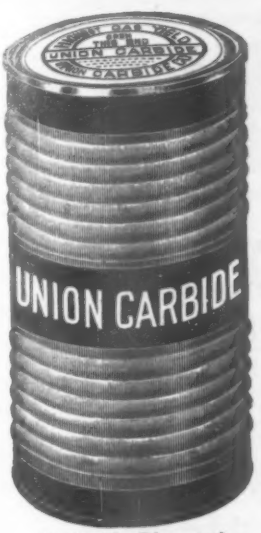

Packed in Blue and Gray Drums

Union Carbide Sales Company

New York City, 30 East 42nd Street — **Chicago, Ill., Peoples Gas Building** — **San Francisco, Cal., Kohl Building**

SOLE DISTRIBUTORS OF

UNION CARBIDE

"World's Best Quality—Highest Gas Yield"

For Oxy-Acetylene Welding Plants

Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

"Union Carbide" is packed in 100-lb. blue and gray drums marked conspicuously, "UNION CARBIDE."

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Phoenix—42 S. Central Ave.

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Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—326-336 Fifth St.
San Francisco—Kohl Building.

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Denver—Nineteenth and Waxee Sts.

CONNECTICUT
Hartford—412 Trumbull St.

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Washington—Maryland Ave. and 9th St., S. W.

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Jacksonville—515 W. Bay St.
Tampa—107 Madison St.

GEORGIA
Atlanta—Cor. Haynes and Rhodes Sts., P. O. Box 1594.
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ILLINOIS
Chicago—Peoples Gas Bldg., Michigan Blvd.
Decatur—133-147 W. Williams St.
East St. Louis—600 Walnut Ave.
Peoria—100-110 Edmund St.
Monmouth—124 E. Archer Ave.
Marion—315 S. Granite St., Box 747.
Quincy—222 S. Eighth St.
Springfield—217 S. 4th St.
Streator—702 East Elm St.

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Evansville—1601 Illinois St.
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Davenport—118 Harrison St.
Des Moines—3rd and Elm Sts.
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Sioux City—925 Fourth St., P. O. Box 398.
Waterloo—1209 E. 4th St.

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Pittsburg—109 W. Third St.
Salina—154 So. 5th St.
Wichita—535-543 West Douglas Ave.

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Louisville—126 E. Main St.
Middlesboro—1701 Cumberland Ave.

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New Orleans—819-21 Julia St.

MAINE
Portland—11 Exchange St.

MARYLAND
Baltimore—19 E. Lombard St.
Cumberland—1 N. Liberty St.
Salisbury—Opp. Fulton Station.

MASSACHUSETTS
Boston—(See Cambridge "A.")
Cambridge—241 Albany St.
Springfield—Napier St.

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Grand Rapids—500 Shawmut Ave., N. W.
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Iron Mountain—215 E. A St.
Jackson—172 South Water St.
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Saginaw—1330 No. Michigan Ave.
Sault Ste. Marie.

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Minneapolis—334 N. First St.
Virginia—413 Chestnut St.

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Vicksburg—1312 Washington St.

MISSOURI
Kansas City—1316-1318 W. Eighth St.
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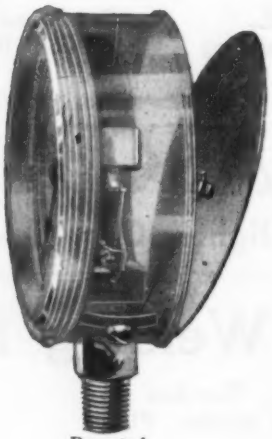
Please address request for information or special correspondence to either the New York or Chicago office.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the Strongest Bronze Made

for high-fire Brazing and Oxy-Acetylene Welding of Malleable Iron or Bronze and Brass castings assure a faultless, flawless job. This is another example of the "Cramp" standard of quality. This scientifically perfected metal is the result of long years of experience. Its fine physical properties make it especially suitable for welding purposes.

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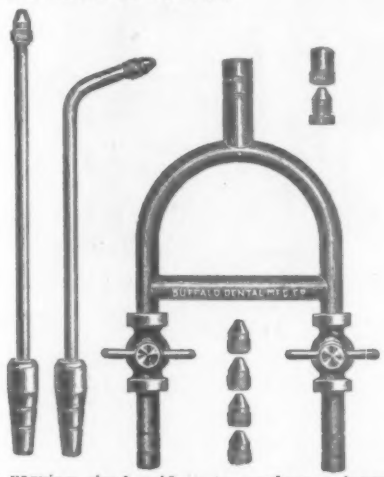

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CONTENTS

Electric Welding Processes—Electric Resistance Butt-Welding Special Butt-Welding Machines and Processes—Electric Spot-Welding—Seam-Welding and Riveting—Percussion Welding—Electric Soldering—Principles of Electric Arc Welding—Applications of Electric Arc Welding—Welding Transformer Tanks by Electric Arc.

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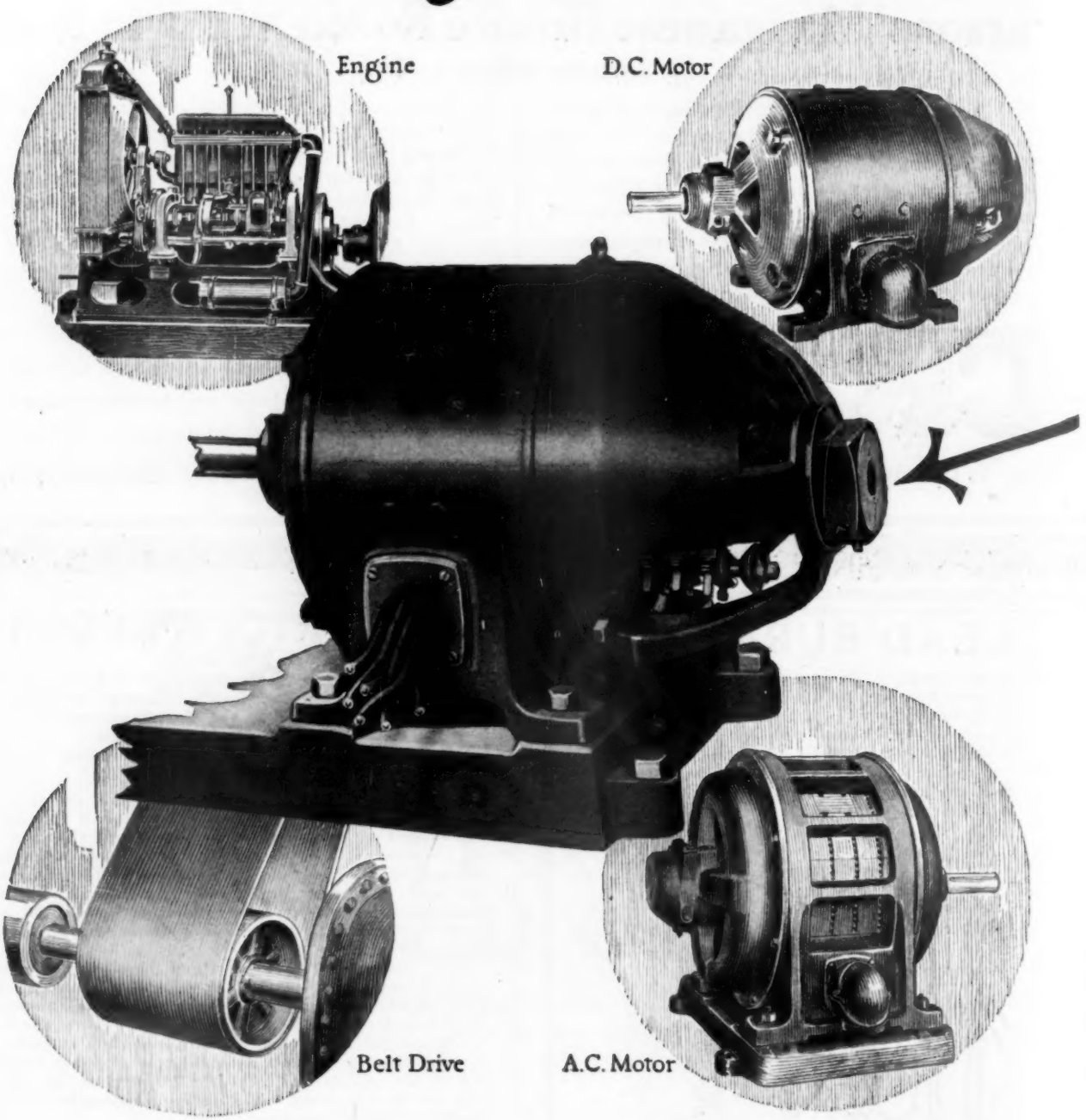

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Two hundred ampere capacity, self-excited, WD-9 Welding Generators can be driven by the power you have.

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Single Operator—
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Single Operator, Portable Unit—

This equipment consists of a motor-generator and control panel mounted upon a truck.

It was designed and built to facilitate the handling of various jobs throughout the shop. This makes it possible to save time and expense, as it no longer will necessitate the complete disassembling of a machine in making repairs.

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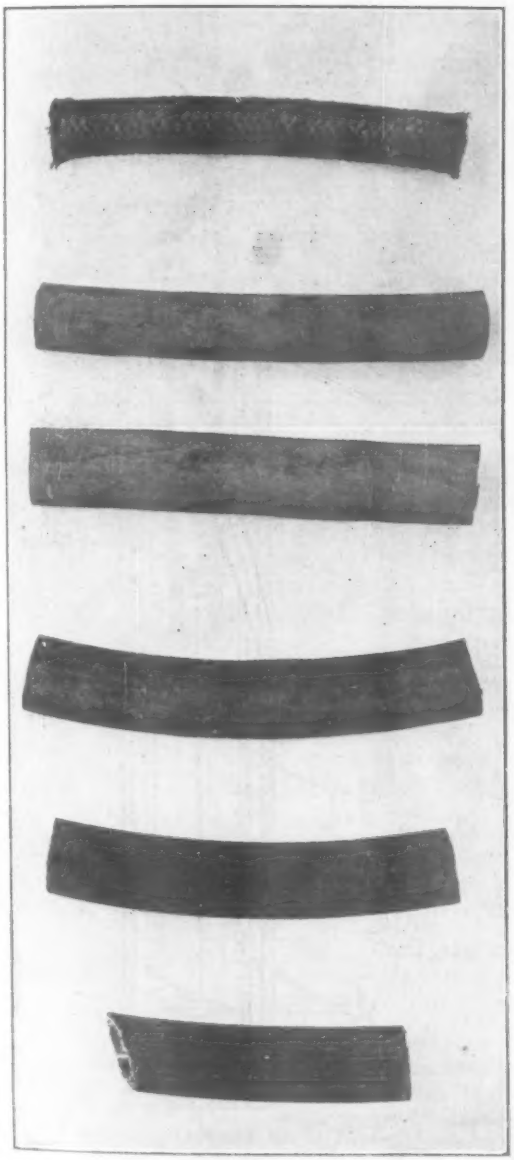

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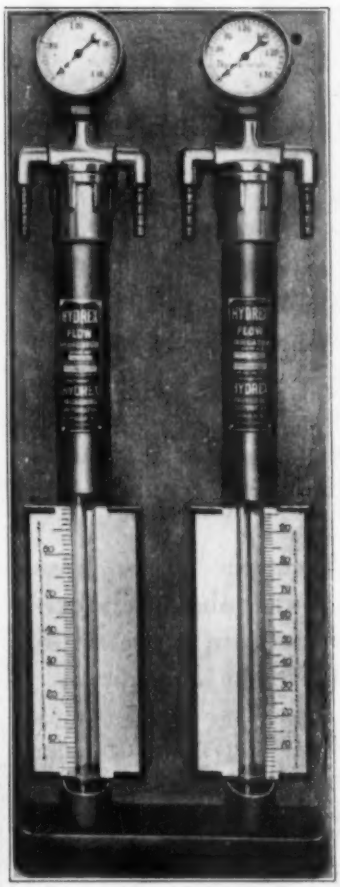
To know what you have done, after you have done it, or to know what you are doing, while you are doing it?



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It is no great task to ascertain, by weighing a tank or by reading a regulator gauge, **about** how much acetylene and oxygen you have used in a certain period, but why not know **exactly**? Why not know while you are working? Why not know at a glance, at any minute, just how much gas you are using, without the bother of weighing tanks or calculating from "per cent of contents" gauges?

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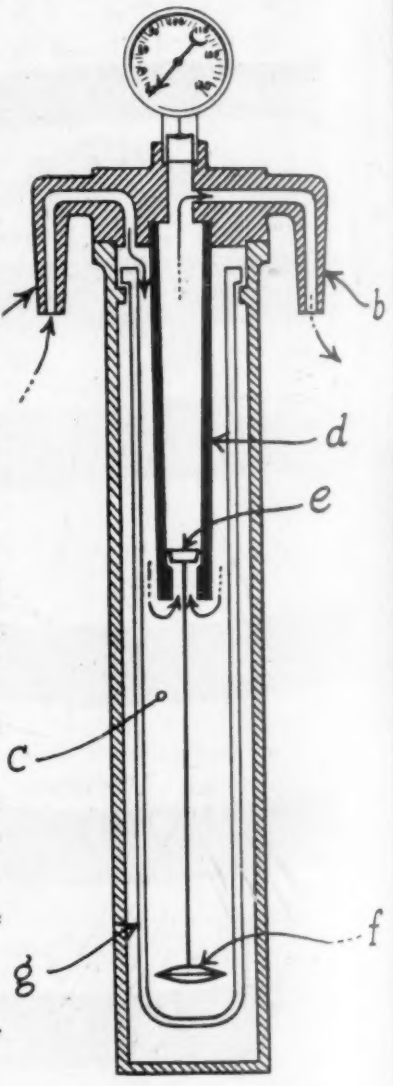
A card will bring a complete description and the evidence.

A request will bring a demonstrator and a trial instrument, without any obligation on your part except to be shown.



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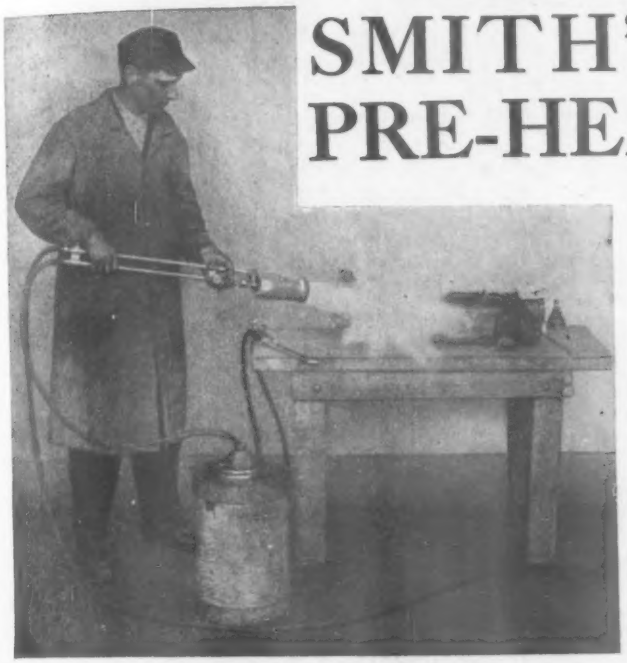

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No heating is required to get torch started. An air line carrying about 40 lbs. pressure drawn kerosene by vacuum system from a tank or barrel and converts it into gas. Torch can be lighted with a match. Flame easily regulated to vary from six inches to four feet.

Strongly and durably made of best materials. A valuable investment for any welding shop.

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For Cast Iron, Brass, Bronze, Malleable Iron, Steel, Cast and Sheet Aluminum.

Anti-Borax Fluxes are scientific preparations which weld at lower heat, leave no scale, cleanse the molten metal, assist fusion and improve the quality of your work.

Anti-Borax Fluxes are the best that money can buy, yet they cost no more—usually less than inferior brands.

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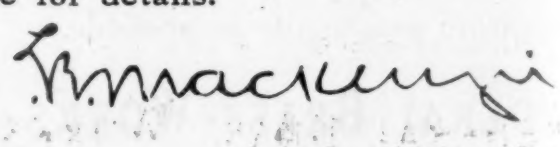
GOOD welding shops are an asset to any community. They should be encouraged and helped. The Editor of The Welding Engineer will be glad to have information and photographs relating to any successful job welding shop.

This page is intended to be a directory of America's best shops. The cost of advertising is low. Write for details.



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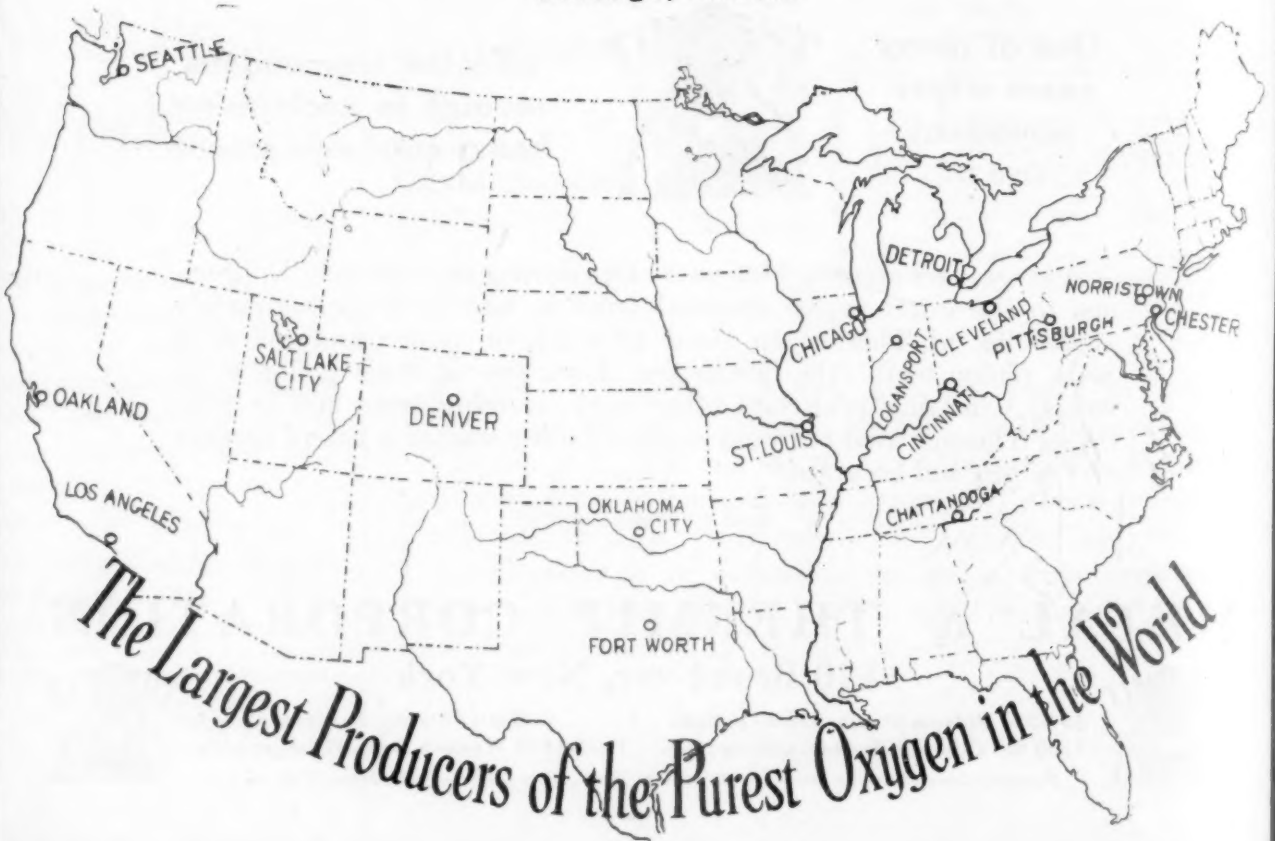

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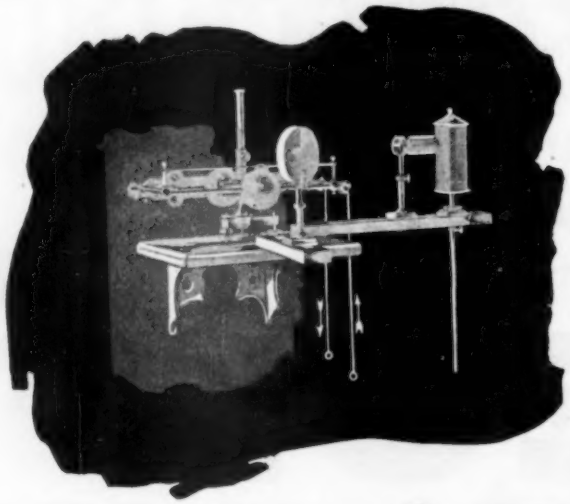

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WELDING AND ITS RELATION TO REPAIR INDUSTRY

By Lorn Cempbell, Jr.

The fusion of metal is usually termed welding. There are four general classifications which might be made of welding in general: the forge; the oxy-acetylene or other gas processes; the electric arc, and the Thermit method. All these methods are used extensively, and while at first glance they might seem to over-lap, in reality at the present time, each has its own field. To attempt a discussion of all welding methods would require considerable time, consequently, we will limit ourselves to the oxy-acetylene process, unless there are questions bearing upon the other questions, which may arise.

Acetylene gas, when burned with a proper portion of oxygen gas, produces an extremely hot flame, in fact the hottest flame known. Its temperature is over 6,000 degrees Fahrenheit. With this flame it is possible to bring any of the so-called commercial metals, namely: cast iron, steel, copper, and aluminum, to a molten state and cause a fusion of tw pieces of like metals in such a manner that the point of fusion will very closely approach the strength of the metal fused. If more metal of like nature is added, the union is made even stronger than the original. This method is called oxy-acetylene welding and differs from what the average layman considers welding in the blacksmith's forge, insomuch that there is no blow struck to assist fusion in this process. And while the forge method is limited to wrought iron and steel which is detachable and of restricted size and shape, the oxy-acetylene process has, practically speaking, no such limitations.

As a manufacturing process a wide field opens up, but as we are limited in our discussion to the repair industry, we will merely hesitate to mention that on the Liberty motors with which you are all undoubtedly familiar there were 87 feet of welding most of which was fusing cast iron to steel. As a repairing agent, the welding torch has no rival. Whether it is a casting of iron, steel, brass, or aluminum that has broken; a boiler or tank that has worn away in spots,, or an error on the part of engineer, foundryman or machinist, the part can generally be reclaimed and made stronger than originally. Today practically no manufacturing concern that is dependent upon metallic machinery could think of being deprived of its oxy-acetylene apparatus, once having learned its worth. In the not far distant past, were a gear or some casting to break, it probably meant closing down the entire plant until a new part could be obtained, which, whether the source of supply was near or at a long distance, would mean costly delay. With oxy-acetylene equipment and an efficient operator on hand, almost every emergency is provided for.

If an automobile owner breaks a frame, he does not consider replacing it with a new one, as the labor alone for stripping his machine and setting it up again, not to mention the cost of the new frame and the time required for this operation, is prohibitive. Rather, he has his car taken to the nearest welder or his portable apparatus to the car and the job is completed within thirty or forty minutes, with the frame at the point of the break made stronger than ever. Locomotive frames are handled in much the same manner, only more time is required and perhaps extra operators, but the important point to be brought out is the fact that on many jobs no dismantling is required and the repair is permanently and quickly executed.

For service in the field on tractors, trucks and other automotive machinery a large percentage of the trouble is occasioned by the loosening of rivets which permits undue strains upon the transmission, the motor and other working parts. The welding torch permits a concentrated flame being played upon the loose rivets and a hot riveted joint being made. For braizing, pouring bearings, straightening bent members, welding water jackets of motors that have been frozen and many other parts too numerous to mention, the welding torch plays a very important part.

For salvaging, from the experimental labatory right down through the entire factory, the welding arch eliminates costly delays. If a casting has been improperly designed and falls short of certain measurements additional metal may be added, lugs built up, and many other parts, which eliminates new patterns being made and the time lost while waiting for new castings. In the factory, machinists errors may be corrected, for if holes are drilled in the wrong place they may be filled up and drilled correctly. Broken taps and drills can be quickly removed, and many other applications found by the wide awake engineer.

Why then, since every emergency is practically provided for, should replacement parts be kept on hand? Lack of efficient operators, is the answer. In turn we ask, why should good operators be lacking? This trouble is due, no doubt, because no means has been provided for the education of welders, and the inability to test a piece that has been welded.

It is surprising to learn how many good men have condemned the entire oxy-acetylene welding process, simply because some careless operators have turned out very poor pieces of work. Perhaps, righteously so, from their standpoint, but we do not think we are overstepping our bounds in estimating that 75 per cent of those who claim to be welders are truly nothing, more or less, than "plasterers" who add metal without any thought of fusing.

How can welds be tested? Directly we are aware of no general rule for testing each particular weld, but this fact should not prevent our learning the skill of the operator. It is quite a simple matter to provide a welder with test bars of the metal generally worked, and have him fuse these bars from one side only. As soon as cold, they can be sawed through the weld and an etching acid applied, or a more simple method is to break the bar through the weld on an anvil, and inspect the fracture. If a good clean break presents itself and the crystals are uniform, it is reasonable to suppose that this operator knows how to fuse that metal, and can be trusted to make similar welds. It is appalling to learn how few are concerned enough with the skill of their operators to test their results. If more care were exercised along these lines, both the welders themselves and the overseers would benefit the industry as a whole.

The oxy-acetylene process of welding presents a very valuable means of making repairs and general salvaging, but in order to obtain the greatest efficiency it is absolutely essential that the operator be educated, first, to know his tools; second, to be able to distinguish one metal from the other;

*Read before the Society of Automotive Engineers, Minneapolis.
†Welding Engineer, United States Welding Co. Formerly Lieut. Ord. Dept., U. S. A., in charge of welding school at Peoria, Ill.

third, to be able to fuse thoroughly the metals he is called upon to weld, and fourth, a general knowledge of contraction and expansion of metals where heat is applied.

Welding and Its Relation to Repair Industry

Welding apparatus in general consists of two regulators equipped with pressure gauges, two lengths of hose, and a welding torch. The regulators are attached to cylinders of acetylene and oxygen and are used to reduce and maintain a uniform pressure of these gases for use at the torch. The gases at reduced pressure are conveyed to the high-pressure gauge to indicate the contents of the cylinder, and also a line or working-pressure gauge to show the gas pressure on each hose. When the gases reach the torch they are there mixed and combustion takes place at the welding tip, which is fitted to the torch. Such an apparatus is called portable, on account of its movability. There are other equipments wherein one or both of the gases are generated, but these will not be discussed here.

There are many small apertures in both the welding torch and the regulators which are required to be kept perfectly clean. The regulators, especially, have many sensitive parts which are constantly subject to much abuse. On the oxygen regulator, a pressure of 2,000 lbs. when suddenly opened against a small seat causes considerable trouble unless all passage ways are kept clean. When the cylinders containing gas have been left out in the rain or storm, it is not an uncommon thing to find dust or rust accumulated in the cylinder valve. This should be all blown out before the regulator is attached to the cylinder, to prevent this foreign matter being carried into the regulator. But there are very few operators, indeed, who observe this practice. To thoroughly appreciate and treat the welding apparatus with respect, it is quite necessary that the welder become acquainted with the tools he works with, so he can make them function properly and real efficiency can be expected.

In the past "flash-backs" were not an uncommon thing, and they caused much loss of time, gas, and inferior welds, but they are now a thing of the past with modern apparatus. We have found that "flash-backs" are caused by an improper mixture of the gases, which increases the rate of flame propagation to such an extent that the flame will flash back to the mixing chamber. Acetylene in a pure state will burn very much slower than when mixed with equal parts of oxygen. When more oxygen is introduced the flame propagation is much greater, so that when an excess of oxygen is used, there is bound to be considerable trouble from backflashing. When sufficient acetylene is introduced to the mixing chamber, there is absolutely no chance for this lean mixture to occur. If the flame flashes back to the mixing chamber, both gases should be closed off immediately, at the torch, the oxygen first, and then the acetylene gas.

In some torches the heating of the mixing chamber will cause a flash-back and with these it is necessary to shut off the acetylene and leave the oxygen valve just cracked and immerse the torch head in water, dipping it slowly, so as not to cause too great a strain. The oxygen will bubble out and prevent the water backing up in the tip. If the flash-back deposits enough soot on the inside of the tip and the head to impair the working quality of the torch, the soot should be removed by using a soft wire, preferably of copper, or some other material which will not mar the tip.

In order to know how to weld, it is quite imperative that the operator first know the kind of metal he is to work on. It is surprising to find how few welders know their metals thoroughly.

Welding and Its Relation to Repair Industry

There are many operators who have trouble in distinguishing such metals as cast iron from malleable iron and cast steel and as each of these metals require a different "filler rod" it is quite necessary that their nature be determined before hand. An incident might be cited where some welders depend upon the sparks given off by the emery wheel in determining the kind of metal they are about to weld. They will approach the wheel; grind off their work, noting the sparks; return to their welding table; choose their filler-rods and do their welding without any delay whatsoever, much to the consternation of their fellow workers. There are four simple ways in common use to distinguish between cast iron malleable iron, cast iron and steel; they are: By casting the cross-section of a fresh break, by application of the welding torch, by the sparks given off when applied to the emery wheel and by the chisel test.

Externally cast iron usually has some sand on its surface and its cross-section shows the grain to be fine, even, and to have a dull grayish color. The surface of malleable iron contains no sand and its grain is very fine, such as cast iron, but slightly darker in color. A very fine steel veneer is on all surfaces of malleable iron, which is much lighter in color. When the welding torch is applied to malleable iron a bright spark is thrown off which breaks in falling, showing that the outside material is steel. Those sparks soon cease and the metal which is molten is covered by a heavy oxide or skin which recedes or draws away from the flame slightly, showing a very porous cast-iron interior. When brought in contact with the emery wheel steel sparks, which are very luminous and break in falling, are given off first in the case of malleable iron, but they soon change to the dull red spark of cast iron. When a chisel is applied to cast iron, the iron chips off; when applied to malleable irons the edge will curl up, then ship off when the cast iron is reached. The cross-section of cast steel shows a bright, coarse, silvery gray grain. When the torch is applied a distinctively steel spark which is luminous and breaks in falling is thrown off. When applied to the emery wheel steel sparks are thrown off; when the edge is chipped by a chisel it will curl up.

The metal in the filler-rod should be the same in practically all cases as the metal to be welded. There are few exceptions to this rule, but the principal one is that of malleable iron. The cast iron in the rods is of a very good grade and generally much better than the piece to be worked upon. To permit the ready flow of the rod and eliminate oxidation, as much as possible, three per cent of silica is used in the casting of filler-rods for cast iron welding. Piston rings and other scrap iron should not be used for filler-rods, as they contain many impurities such as core-sand, dirt, grease, etc., which will ruin the weld. It is disheartening to see some operators attempt to economize on the filler-rod. It is not an uncommon sight to see several dollars' worth of gas and the same amount of the welder's time, together with a few cents' worth of filler rods all lost, and the operator's reputation ruined. This because an attempt is made to save the few cents involved in the filler-rods by substituting a rod of a very poor grade.

A flux is not used, as many suppose, to cement the filler-rod to the metal. It is used purely as a cleaning agent and may be likened to the acid used in soldering. It does not act on the metal until the latter has reached the melting point, but then it starts to break up the oxides and clean the surface. This action permits the metal to flow together more readily. A cast-iron flux is always used in welding cast iron, to break up the oxide, because the cast iron itself will melt before the oxide and no matter how hot the metal is it will not flow together as long as this oxide is present.

To obtain the best results, reliable fluxes should always be used. The flux is generally applied by means of the filler-rod. One end is heated and dipped in the flux; enough will adhere to break up part of the oxides, on the ordinary-size

(Continued on Page 46)

RULES FOR AUTOGENOUS WELDING

The following rules adopted by the Committee on Standards for the purpose of preventing the use of autogenous welding for purposes for which it is not well adapted, have been sent to the regional directors by Frank McManamy, assistant director of the Division of Operation, with instructions to direct all roads to observe the rules in the construction or repair of locomotive boilers, so that any failures which may have been caused or contributed to by unrestricted or improper use of autogenous welding may be prevented.

The Committee on Standards, after carefully investigating the use of autogenous welding in connection with the construction and repair of locomotive boilers, and fire boxes, has, in the interest of safety and efficiency, adopted the following rules:

1. Autogenous welding will not be permitted on any part of a locomotive boiler that is wholly in tension under working conditions; this to include arch or water bar tubes.

2. Staybolts or crown stay heads must not be built up or welded to the sheet.

3. Holes larger than 1½ inches in diameter when entirely closed by autogenous welding must have the welding properly stayed.

4. In new construction, welded seams in crown sheets will not be used where full-size sheets are obtainable. This is not intended to prevent welding the crown sheet to other fire box sheets. Side sheet seams shall not be less than 12 inches below the highest point of the crown.

5. Only operators known to be competent will be assigned to fire box welding.

6. Where autogenous welding is done, the parts to be welded must be thoroughly cleaned and kept clean during the progress of the work.

7. When repairing fire boxes, a number of small adjacent patches will not be applied, but the defective part of the sheet will be cut out and repaired with one patch.

8. The autogenous welding of defective main air reservoirs is not permitted.

9. Welding rods must conform to the specifications issued by the Inspection and Test Section of the United States Railroad Administration for the various kinds of work for which they are prescribed, which specifications will be issued later.

PRESSURE WELDING IN INDIANA

Editor: I have been reading the January *Welding Engineer* and have read with interest some of the articles concerning boiler welding and inspector's reports and feel a deep humility that my native state of Indiana should adopt such an attitude as regards welding of pressure vessels.

Riveted patches fail also. Why not prohibit the use of the riveted patch?

There is one explanation and only one for this movement. It is the pressure the narrow-minded shop crafts or labor unions are bringing to bear on the matter. Do not think I am opposed to collective bargaining, I am not, but I am most strongly opposed to the attitude of the so-called shop crafts on welding.

I was in Kansas City in June, 1919, and visited some railroad shops there. I, of course, asked who the welder was and was invariably informed that each craft did its own welding. That is, when a machinist or any other craftsman had a job that required welding, he did it himself. My answer was the same in every instance. "I can easily see that by looking at the work of welding they did."

I have welded tubular boilers for steam automobiles that withstood a hydraulic pressure of 3,000 pounds and in service carried a steam pressure of 1,000 pounds.

At a large plant near Indianapolis there are large hydraulic presses that press out cylinders. The high-pressure pipes carry such a high pressure that a coupling or an ell will not hold at all. They are welded now and it invariably holds. Needless to say, beginners are not allowed to weld these pipes, the walls of which are one inch thick.

Why did not the farmers who compose most of the law-making body of Indiana go out to that plant and learn something? The name of that plant is as familiar as the word automobile.

I have seen gas lines in Oklahoma carry 250 pounds pressure continuously and they are all welded end to end. Will they tear them up and couple them by the old-fashioned method? A boiler maker's apprentice said to me the other day: "There isn't nearly as much to your trade as there is to mine. I don't see why you are getting 5 cents per hour more than the other mechanics. Why anybody can weld." It is this attitude that is causing such hateful legislation.

However, I notice that when the Government wanted welder teachers to instruct the soldier students, they did not call on the boiler makers, the blacksmiths or the machinists, either. They called for the professional welders. The only solution of the problem is to have laws passed requiring the licensing of every welder and have a just system of classifying them. The sooner this is done the better it will be for the welding fraternity.

F. E. Totten.

NEW WELDING SCHOOL

A class in oxy-acetylene welding has been started at the Ralston School, Pittsburgh, Pa. At this school steamfitters

Welding Class at Ralston School, Pittsburgh.

and plumbers both have classes for instruction in oxy-acetylene welding. This school has recently added to its equipment three complete "Airco 'A'" welding outfits.

WELDING CAST IRON

Editor: Mr. Julian's article in the January issue we must admit was very interesting to say the least. No doubt, we have all had our bitter experience on cast iron and its expansions and the welders may have a wide field of experience and yet have their old troubles turn up just when least expected, as you can never say the wonderful expansion question has been overcome. I find as a rule, nine times out of ten, we start the job without figuring from start to finish. Careful thought should be given each operation from the building of the furnace to the taking out again. In referring to blow holes, I find I never

have any trouble when using flux freely and fusing the metal thoroughly, watching to remove all foreign elements. If this precaution is taken and the blow holes are visible, then it must surely be an improper flame, or drawing the acetone, which is often the case. The welder that never makes mistakes never gets very far and is not very interesting to listen to. My experience with making a soft weld is to run my weld as fast as possible with my flame at a proper distance, so as not to blow my metal and with one puddle finished let it remain so and start my next puddle and proceed until the weld is finished, bearing in mind not to use too much flux on the surface, as it has a tendency to make a hard crust on the surface. In welding machine parts, such as arms and brackets with one or more shaft holes which require accuracy, I find that by tacking first and melt out the weld after pre-heating much trouble will be eliminated.

Repairs to cast iron wheels and overhead pulleys should not be welded if broken very badly, as it is very dangerous working underneath, as a complex expansion and contraction is very hard to overcome. I find if a pulley is broken at two or more places on the rim, by heating to cherry red you have a proper expansion and by melting out say ⅛ inch on the last weld will give you plenty of room for your complex contraction. If any arms are broken and also the outside rim it is practical to weld the arms first and then the rim last of all. I find that by heating all over to an equal heat you always have good results as the days of taking chances are over. Then again by preheating all the oil and grease will be absorbed and no danger of blow holes from that source.

P. S.—I would like to hear from that welder who welds his cast iron by the cold process, as I am very anxious and willing to learn all different methods. S. L. Wert.

WELDING SCORED CYLINDERS

In the October, 1919, issue of Autogenous Welding, I note that you state that the welding of scored cylinders is too expensive. I feel that the statement is probably too general. It is very common practice to treat automobile cylinders in this way, regrinding the cylinders, and either adding metal to the pistons below the rings and fitting new rings, or applying new pistons. We have done this many times at a great saving over new cylinders.

With a gas engine cylinder, the case may be different, because of the difficulty of finding a machine to grind it on. But even in such cases it is many times possible to grind out the weld with a flexible shaft emery wheel, removing most of the metal, and then rebore the cylinder on a boring mill. The piston can be handled as above.

The method you give does not make a first-class job, although it may answer in some cases. What to do depends on what the cylinders are worth, and what kind of a job is wanted.

It should be remembered that repeated heating and cooling of cast iron deteriorates it, and it becomes weak and brittle, so that it may not be advisable to apply this method too frequently.—S. W. Miller, Rochester, N. Y., in Autogenous Welding.

The Kentucky Oxygen-Hydrogen Company, Louisville, Ky., announces that they have the first oxygen plant in the United States to secure the approval of the Underwriter's Laboratories, Inc., and the right to use its name together with the inscription "Inspected," with respect to their plant, its operation and products.

WELDING IN MONTREAL

A prominent Canadian firm of welding engineers, the St. Lawrence Welding Co., Ltd., of Montreal, is specializing in the manufacture of all kinds of welded tanks, for all purposes and of any size and shape. The equipment of this company

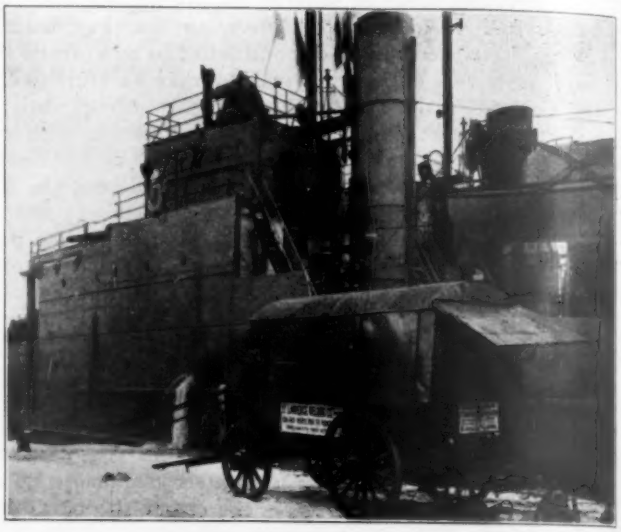


Fig. 1. Working on an "Eagle."

includes thermit, electrical and oxy-acetylene apparatus. A machine shop, foundry, blacksmith shop and boiler shop is also operated, together with portable arc welding equipment. The portable equipment shown in Fig. 1 is working on an American Eagle boat. It will be noted that the equipment is not mounted on an automobile truck, but is mounted on a heavy farm wagon. Because of the severe winters experienced

Fig. 2. Welded Cast Iron Water Wheel.

in Montreal this is of great advantage, because automobile engines freeze. In the winter time the wheels are removed from this truck and runners substituted. The welding equipment consists of a Lincoln electric gasoline driven set, of

200 amperes capacity, with 400 feet of double cable and a 8 by 8-inch gasoline driven air compressor. These equipments are replacing the company's sea going welding tugs, one of which was illustrated in *The Welding Engineer* last year. The slogan, "We Can Weld Anything, Anywhere," will be noticed on the rear end of the truck.

Many interesting welding jobs are handled in this plant. One of them is illustrated in Fig. 2. This is a cast iron water wheel with steel buckets. This wheel was welded by the electric welding process, using a pencil electrode and a special flux which greatly assists electric welding on cast iron. It will be noticed that this photo was taken immediately after welding. The rough finish shown in photo was afterwards removed by air grinders, and this job was turned out in a very satisfactory and workmanlike manner. The wheel has been in use for at least six months and on a recent examination, it was found that none of these buckets have become loose and the wheel is even better than a new one.

Their tank department is fully equipped to handle from ⅛ to ¾-inch plate. They can roll sheets 22 feet wide by 1 inch thick, can cut up to 1½-inch plate and punch 1½ by 1½ inches. They also have a small set of power rolls to handle

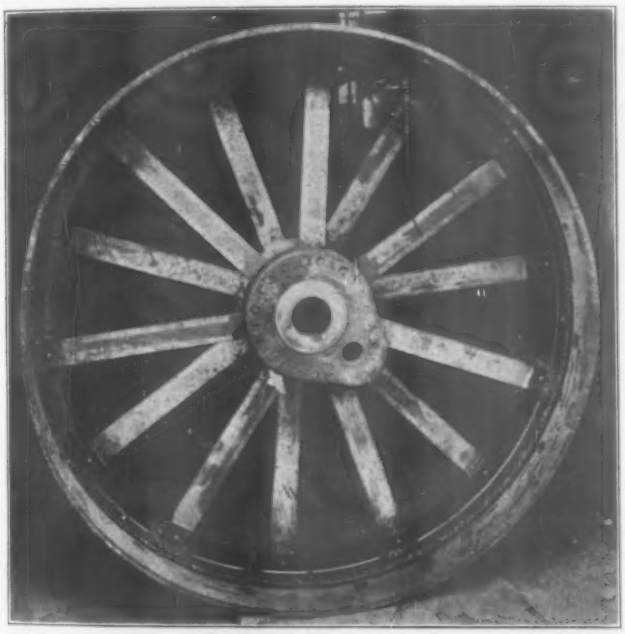


Fig. Steam Roller Wheel.

the smaller and lighter sheets. Among other tools, they have a bar iron cutter, capacity 1½ inches; angle iron and T iron cutter, up to 4 by 4 inches, and an angle iron roll. The flange shop is equipped with hydraulic presses and flange fires is fully equipped to dish and flange up to 6 feet in diameter by ¾-inch plate. They also have a set of clamps 22 feet long and a small set 8 feet long. The tank department occupies a floor space of 8,000 square feet, has three entrances for teams, there also is a trolley system running throughout the shop and jib cranes over all of the heavy machinery. They claim to have one of the best equipped tank shops in Canada.

Fig. 3 is a view of a steam roller wheel which was repaired in this plant. This wheel had a cast iron rim with steel spokes broken in several places, and the spokes loose in the rim. They broke away all of the old rim, rolled a piece of plate ¾ by 28 inches by 6 feet in diameter, punched the necessary holes in it for the dogs that have to be used occasionally. You will see these punchings quite clearly in the photo, punched holes for riveting the T iron to the tire rolled on a piece of 4 by 4-inch extra heavy T iron for the inside, riveted the T iron to the tire, riveted spokes to T iron as shown, then electric welded the whole together.

This job has resulted in no less than seven more being sent to their works for similar repairs.

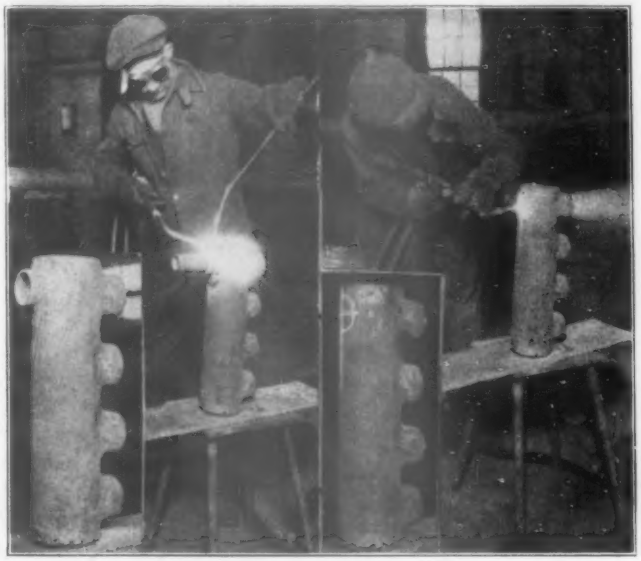
WELDED HIGH-PRESSURE STEAM MANIFOLDS

The manufacture of high-pressure steam manifolds by the acy-acetylene process has become standard practice in the shops of an important Pennsylvania engineering company.

The construction of such manifolds by oxy-acetylene welding and cutting provides not only an easy method of manufacture, but results in a construction of great strength and pressure withstanding qualities.

In welding one of these branches a piece of 4-inch steel pipe 18 inches long is used. The centers for the sleeves are chalked off and holes cut by a cutting torch. Then the first socket is lined up and welded, others following until the job is completed. Nipples are placed in the sockets in order to protect the threads during welding.

Following the welding of the sockets, disks of the proper thickness are cut and welded in each end of the manifold. These disks are chamfered so that when placed in position in the manifold the necessary bevel or V for a strong weld is secured.



Steam Roller Wheel.

To weld a manifold complete takes about two hours. Approximately 80 cubic feet of Airco oxygen and 70 cubic feet of Airco acetylene are necessary for each job.

The view at right center shows a semi-completed manifold, a chalked circle for the inlet socket. At the right the operator is cutting the circle. At left he is welding in the socket. At left (bottom) the finished manifold is shown.

Mr. Augustine Davis has resigned as president of the Davis-Bournonville Co.

Mr. Davis was a pioneer in the acetylene lighting and oxy-acetylene welding industries in the United States, and actively connected with those industries up to this time. He founded the Davis Acetylene Co. and the Davis-Bournonville Co., and has been president of both companies since their organization. The Davis Acetylene Co. was dissolved in 1917.

Mr. Elmer W. Christy has been authorized by the United States Government to open a War Department welding school at Camp Pike College, Camp Pike, Ark. Mr. Christy wishes to get in touch with a capable instructor.

ARC WELDING APPARATUS *and* ITS APPLICATIONS

A. M. Candy*

(Continued from the January issue.)

Coated or wrapped electrodes have been on the market for a number of years, some of which are admirably suited to certain classes of work. The coating on the electrode is fused during operation and forms a protective gas around the arc stream, also a protective slag coating over the molten deposited metal. The effect of the gas envelop is to maintain the arc current constant as indicated by Fig. No. 23. When a complete weld cannot be made by a single de-

Fig. 24.

posit the slag must be removed from the deposit before additional metal is deposited. Even with great care slag inclusion is a danger as indicated by dark areas shown by Fig. No. 24. However, bare electrodes sometimes produce slag inclusions in the deposit as indicated by Fig. No. 25. This may be due to oxidation of the wire, rust on the wire or slag imbedded in the wire, and is accentuated when the wire melts in large globules as indicated by hot rolled steel deposit Fig. No. 26.

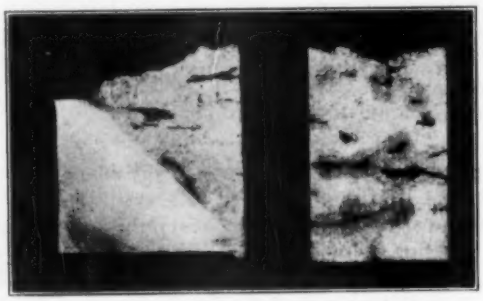


Fig. 26.

Probably the greatest advantage of the wrapped electrode is that welds made with it are considerably more ductile than welds made with a bare electrode. Furthermore, the chemical composition of the deposit can be quite readily controlled by varying the composition of the electrode because the various alloying constituents will be protected by the wrapping and will not be oxidized and lost to the extent observed in the case of bare electrodes.

The electrode material from bare electrodes when passing through the arc in finely divided particles or vapor goes through a marked refining which results in the reduction of the carbon and manganese contents to a great degree as indicated by the following table Fig. 27:

Fig. 27

Analyses of Electrodes and Their Deposits

Electrode.	Carb.	Mang.	Phos.	Sulp.	Silic.
A (Roebling)	0.16	0.56	0.032	0.024	0.016
Deposit	0.05	0.18	0.031	0.036	0.011
B (Norway Iron)	0.049	0.021	0.025	0.007	0.08
Deposit	0.05	0.018	0.020	0.015	0.011
C (Cold Rolled Steel)	0.11	0.72	0.097	0.123	0.011
Deposit	0.05	0.11	0.086	0.072	0.011
D (Quasi-Arc)	0.07	0.003	0.051	0.044	0.011

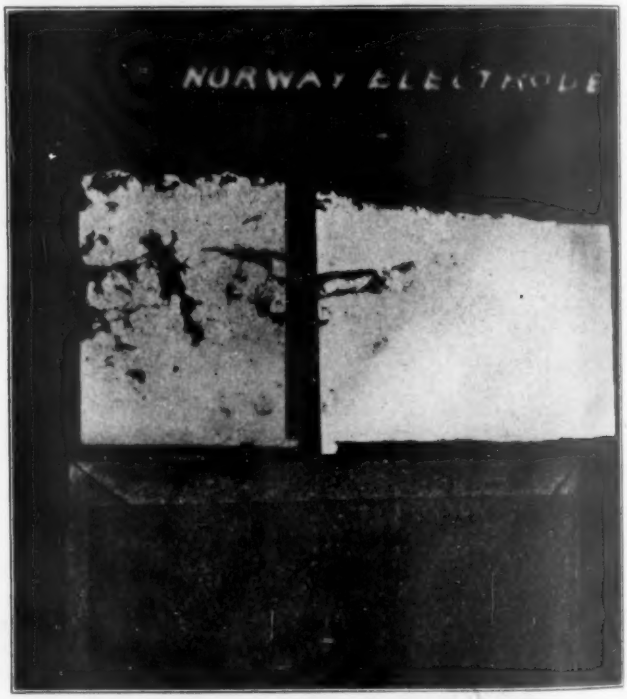


Fig. 25.

Deposit	0.03	0.021	0.042	0.046	0.058
E (Hot Rolled Steel)	0.17	0.50	0.012	0.045	0.011
Deposit	0.14	0.14	0.012	0.039	0.011

In the case of Roebling for example the carbon is reduced from 0.16% to 0.05% and the manganese from 0.56% to 0.18%.

The deposit therefore aproaches commercially pure cast iron. The original electrode however should have as much of these elements as indicated originally because the formation particularly of carbon monoxide and carbon dioxide helps to protect the iron from the air and thereby minimizes the formation of iron oxide. An electrode such as the hot rolled steel, which tends to pass thru the arc in large globules.

*Gen'l Eng. Dept., Westinghouse Elec. & Mfg. Co.

or the metal from coated electrodes are not effected to such a degree as indicated by E and D respectively. The large globule prevents the air from coming in contact with so much carbon in the globule, and the coating serves the same purpose.

The carbon content of the electrode has a material influence upon the melting temperature as indicated by Fig. 28. To insure good penetration, good fusion and a minimum amount of overlap of the deposit on unfused areas of the work, the melting temperature of the electrode must be at least equal to that of the work. Under these conditions the amount of penetration and overlap will be about as indicated by Fig. 29 and 30. If the melting temperature of the electrode is considerably in excess of the plate then there will be practically no overlap as indicated by Fig. 31. (At right). Excessive overlap is undesirable because it results in unfused areas and will also entrap oxide in the finished weld, see right side of Fig. 32. To minimize this effect the melting temperature of the electrode should exceed that of the plate.

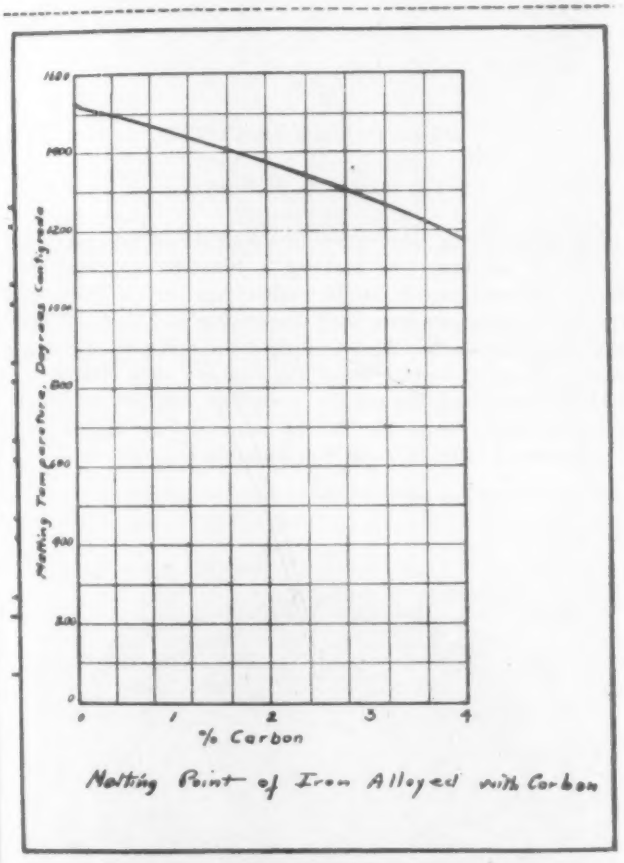


Fig. 28.

Commercially pure iron possesses the highest melting temperature, however, it is not advisable to use this material because excessive oxidation will result. Commercially pure iron alloyed with about 0.18% carbon and 0.5% manganese will materially reduce this trouble without appreciable sacrifice in melting temperature. The extreme condition of no overlap is difficult to obtain, however, a slight amount of overlap as indicated in Fig. 29 will do no harm as it can be practically eliminated by properly depositing subsequent layers as will be explained later.

Penetration and overlap are not only functions of the electrode characteristics but are also functions of proper current volume, the maintenance of a short arc and the subsequence of filling as will be explained hereinafter.

Use Correct Current Volume

This question places us face to face with, probably, the most important phase of arc welding, namely proper fusion; how to obtain it and how to determine if a finished weld is properly fused. Proper fusion is a function of the first principles cited on page 15. Of these principles cited on

Fig. 29.

page 7. Of these principles the third is undoubtedly the most important.

The proper current volume is dependent upon the thermal capacity of the material at the point where welding metal is to be deposited. The thermal capacity is dependent upon the characteristics of the material, its temperature and the shape and thickness of the parts where the weld is to be made. The size of the electrode used must be consistent with the current used if the electrode is to be properly fused. For butt welding the edges of mild steel plates (See A, B, C, D, H and I of Fig. 18) current values and electrode sizes as indicated by the left hand side of the area "Plate Thickness Vs. Arc Current," see Fig. 33. If, however the plates are overlapped at the point where the weld is made as indicated at "E" and "F" Fig. 18 then the current values and electrode sizes must be selected from the right hand side of the above mentioned area If the plates to be welded

Fig. 30.

Fig. 32.

are lying in contact with some heavy plate or casting, then the thermal capacity at the weld is much greater than if the two edges of the plates are supported free in air. To illustrate the above points we have found that a butt weld between plates 1/2" thick not in contact with any metal at the joint (see Fig. 34) can be made satisfactory with 125 amperes whereas if the edges of the plates are overlapped a current of 225 amperes can be used although satisfactory results can be obtained with 175 amperes. If the 125 amperes

current is used in this latter case the deposit will not penetrate into both plates as indicated at lower left of Fig. 34 whereas if 175 to 25 amperes is used the deposit will penetrate the plate as at lower right of the figure. Figs. 35 and 36 are beautiful examples of satisfactory penetration

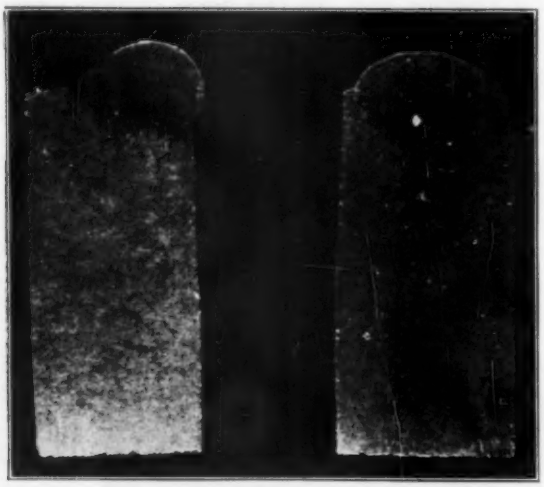


Fig. 31.

of a deposit formed on a 0.4% carbon steel shaft which was built up.

That the proper current volume is necessary to produce a strong weld is evidenced by Fig. 37. The left hand sample was made with a sufficiently high current to produce good fusion and therefore when it was pulled the specimen broke thru the filler. The right hand sample was made with too low a current value and as a result the fusion between the deposit and the original was poor so that it broke along the upper scarfed surface. Fig. 38 also shows weld strength variation with arc current. In Fig. 39 we have an indication of the variation of the percent strength of weld with the percent of proper welding current. The curve "A" represents the performance of a good operator and curve "B" a medium good operator so that the enclosed area represents the per-

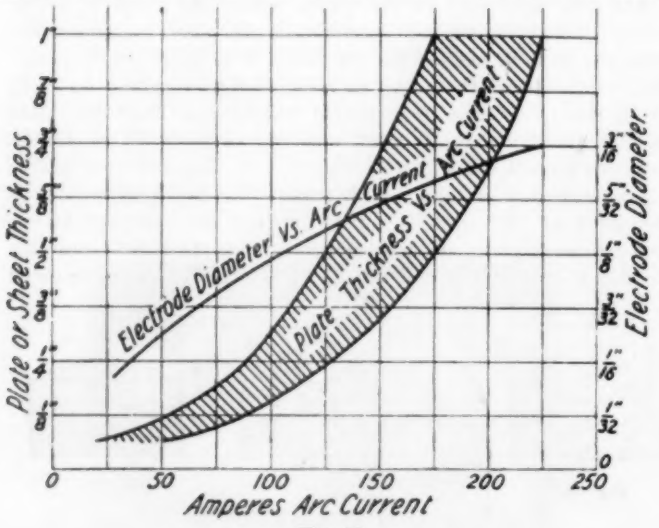


Fig. 33.

formance of an average welder.

The above considerations lead naturally to the question—How can the operator determine whether good fusion is being secured? When the D. C. welding arc is broken a crater is always formed at the end of the deposit as indicated by Fig. 40. The depth of the crater is a very accurate index of the depth of the deposit peneration into the plate. To show the depth of the crater the piece in Fig. 40 was cut in two through the row craters as indicated by Figs. 41 and 42. The upper end of the piece (Fig. 40) was ground polished and etched to show the depth of penetration as indicated by Fig. 43. By comparing Fig. 41 and Fig. 43 the relation between crater depth and deposit penetration is obvious.

If the arc current is too low the metal will not penetrate into the work as indicated at left of Fig 44. If the arc is too high the penetration will be excessive as shown at right.

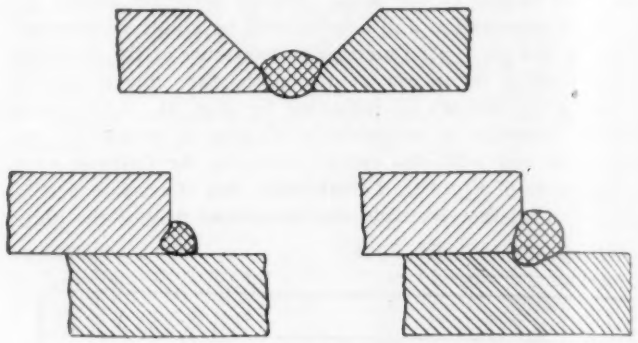


Fig. 34.

WELDING SHOP COSTS

By Joseph N. Robinson

That some shops poorly located and doing but a medium amount of business are making a financial success, while others with apparently all the advantage and a large turnover are coming out too near the wrong end of the ledgers are well-known facts. And a study into conditions prevailing in many shops will soon show the reasons very clearly.

While there will always be a certain number of failures among welding shops due to the same causes appearing in other business failures, such as incompetence, ignorance, lack

Fig. 35.

of capital, extraordinary local conditions, etc., still there are others which when examined show causes which could easily be remedied by the shop owner with but little expense or effort. One of the most important of these is the method of calculating the real cost of work.

This is just as important for the financial success of the shop as proper welding. To turn out good jobs at a loss is just as bad business as to turn out poor pobs at a profit. Both courses will eventually lead to a severe contraction of the bank account.

Fig. 36.

Nor is a proper system of cost finding necessarily a difficult, intricate, expensive arangement, even for the smallest shop. Too many men are afraid of the very mention of such things and usually because they know all too little about them.

Cost Card

The other supplies used on each job can easily be taken care of. In order to handle a cost system, such as is being

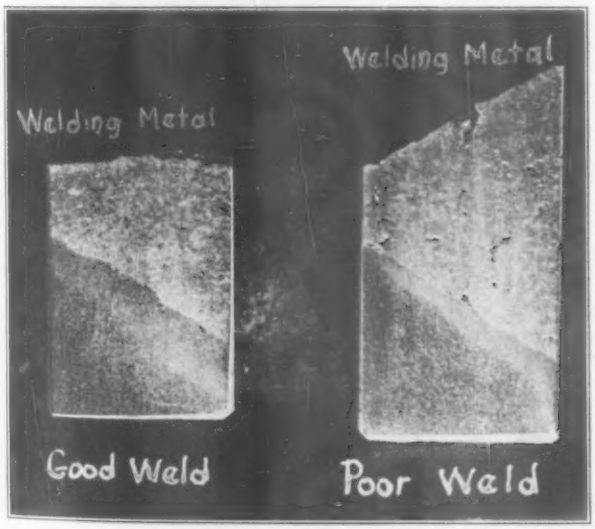


Fig. 37.

described, properly, every job as it enters the shop should have some kind of a printed card attached to it, on which can be entered the items mentioned. This card should be printed to show the following, and can be made out by the welder or foreman:

Job number, or name of customer.
Article.
Description of repair to be made.
Amount of oxygen used.
Amount of acetylene used.
Labor.

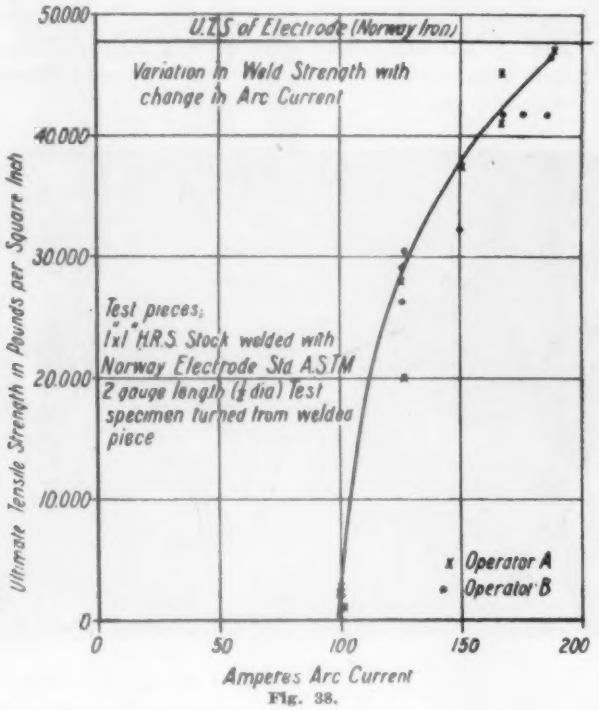


Fig. 38.

Welding rods.
Flux.
Preheating materials.
Sundries.

When the job is completed, the card is sent to the office, where the prices for each item are entered and extended, and the "hour cost" and profit added.

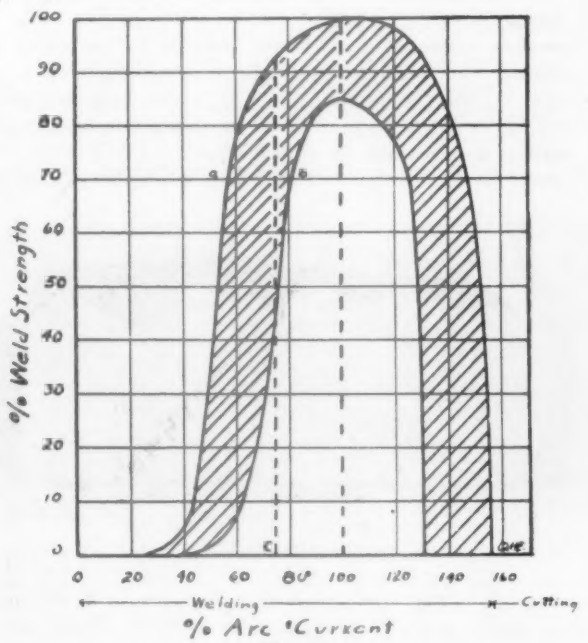


Fig. 39.

In calculating the cost per cubic foot of the gases the welder must be careful not to use merely the invoice price, but must also add on freight and cartage charges both ways. This usually runs from ¾ to 1 per cent per foot according to listance from the source of supply.

The invoice can then be made from this card, and the

welder or the owner of the shop can rest assured that he is neither cheating himself nor his customer.

Very often a man comes into the shop with a broken metal part to be repaired, and wants to know the cost at once. The welder has to make a rough guess. He may guess too low, and lose money. He may guess too high, and lose the job. It has often been pointed out, and is again emphasized here, that the welder should try to impress upon his customers the fact that in the big majority of cases it is

Fig. 40.

impossible to estimate fairly on a job, and that the welder, in order to protect himself, must put the price up high enough to make sure of covering any unforeseen contingencies—and even then he may lose—while if the customer will only rely on the honesty and integrity of the welder and forget about the price until the job is finished, both customer and welder will get a square deal, the former paying only for the actual work done, and the latter being sure of not losing.

However, sometimes it is not possible to get away from estimating. In such cases, if the welder has been keeping his cost records up to date, he will have something definite to base his estimates on, and will stand a much better chance of putting a fair price on the work.

Many other job systems are in use, which may be as good

Fig. 41.

or better than that outlined here. Any one of them is good if it is simple and will "produce the goods." There are just four points to remember when calculating costs: Have a system. Be sure it is right. Be sure it is simple. STICK TO IT.—Canadian Welding Journal.

If these men would just give a few hours' careful study to various systems which have proven successful they would invariably find where they could improve their own methods. This article gives a brief outline of a system that has already proven a money maker for the user, and if others would follow it they, no doubt, would also see its benefits.

Overhead Cost

The average small shop of any kind is not usually run with proper attention to the real cost of the work. This is especially true of welding shops, because it is not generally understood that there are other costs besides those of gas, supplies and labor. Such expenses as interest on investment, depreciation on plant and apparatus, rent, insurance, taxes,

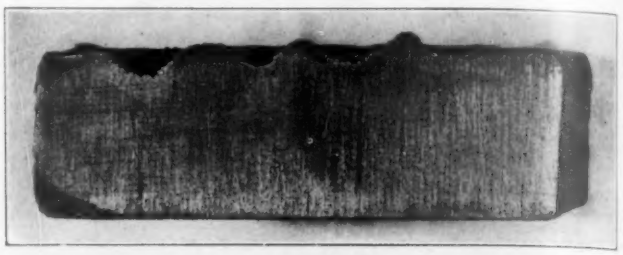


Fig. 42.

advertising, light, heat and power, bookkeeping and office expenses, collections, bad debts, soliciting business, etc., have to be paid out of the earnings of the shop, although they are not generally taken into account in the proper way. Many welding shops—and not always the small ones—have come to grief by not paying the proper attention to these matters. Again the cost of gases is frequently taken at the invoice price, without considering freight and cartage which have to be paid both ways.

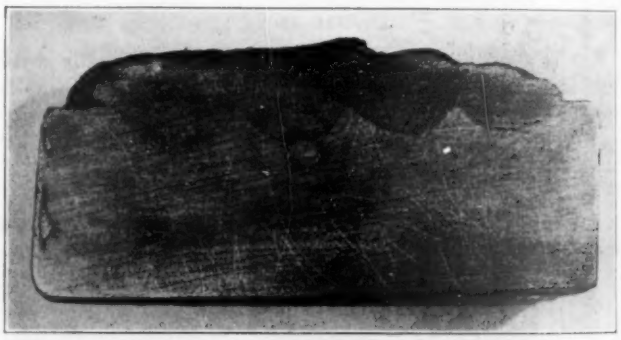


Fig. 43.

Let us take a practical example and work out all these items and arrive at what in many plants is called the "hour cost," which includes all overhead.

Assume that the plant has cost $1,000, and that the fixed charges will be as follows: Interest on investment, 6 per cent; depreciation on plant and apparatus, 10 per cent; repairs, 5 per cent; insurance, 2 per cent; taxes, 1 per cent. The operating expenses might be as follows: Rent, $35 per month; heat, $5 per month; light, $2 per month; power,

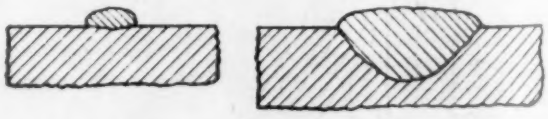


Fig. 44.

$5 per month. There will be miscellaneous other charges according to the class of work being done, and local conditions, also the bookkeeping and office expenses, postage, collecting, advertising, soliciting business, and other items, say, $75 per month.

A total of these charges, exclusive of the owner's time and labor, would come as follows:

Interest on investment, 6 per cent of $1,000	$ 60
Depreciation on plant, 10 per cent of $1,000	100
Repairs, 5 per cent of $1,000	50

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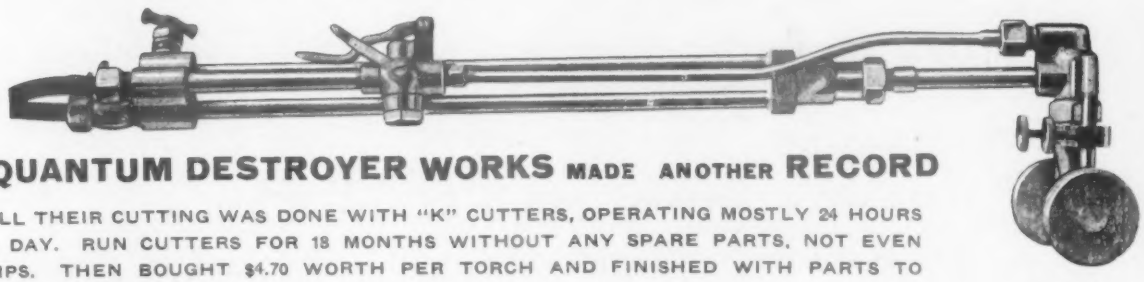

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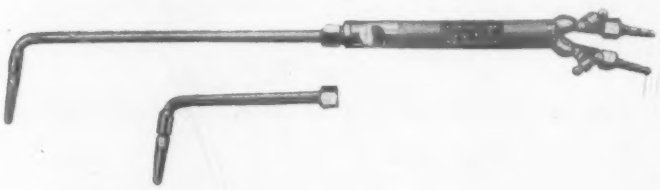
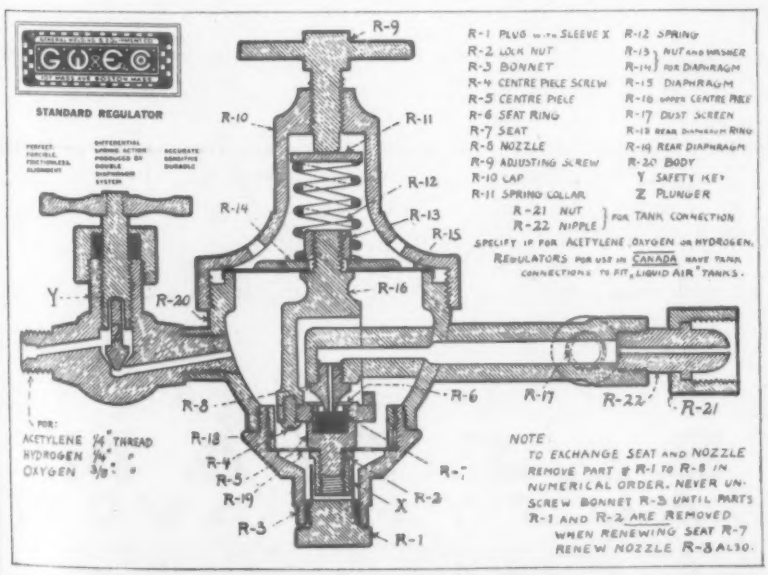
ALL THEIR CUTTING WAS DONE WITH "K" CUTTERS, OPERATING MOSTLY 24 HOURS A DAY. RUN CUTTERS FOR 18 MONTHS WITHOUT ANY SPARE PARTS, NOT EVEN TIPS. THEN BOUGHT $4.70 WORTH PER TORCH AND FINISHED WITH PARTS TO SPARE. SOME RECORD!



STANDARD WELDING TORCH STYLE "W"

THIS IS NO EQUAL PRESSURE TORCH, NOR A BALANCED PRESSURE ONE, NOR A TIP-MIXER, ETC.; IN SHORT IT IS FREE FROM ALL AND EVERY NOISY ACCOMPLISHMENT. IT USES JUST ENOUGH PRESSURE TO SAFEGUARD THE OPERATOR. IT WORKED WITHOUT FLASHBACKS LONG BEFORE THOSE NEW DISCOVERIES WERE BORN. IT IS USED BY THE MOST PROMINENT CONCERNS. EACH TORCH IS FURNISHED WITH A SHORT EXTENSION TO HAVE A 16-INCH LONG TORCH, AND A LONGER EXTENSION TO HAVE A 22-INCH LONG ONE THUS YOU REALLY HAVE TWO TORCHES IN ONE.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R-6 SEAT RING
R-7 SEAT
R-8 NOZZLE
R-9 ADJUSTING SCREW
R-10 CAP
R-11 SPRING COLLAR
R-12 SPRING
R-13 } NUT AND WASHER
R-14 } FOR DIAPHRAGM
R-15 DIAPHRAGM
R-16 UPPER CENTRE PIECE
R-17 DUST SCREEN
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R-21 NUT
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NOTE
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Extruded metal—compressed by 600 tons hydraulic pressure—is used for needle valves, the valve body and the head. Extruded metal is close grained, tough and homogenous—there can be no sand holes or shrinkage cracks.

The female seat for the tip is renewable—if seat is damaged it isn't necessary to ship torch back for repairs.

There are no valves inside the handle—every valve is easily "get-at-able". A leaky valve inside a handle is a nuisance and may be dangerous.

The torch is sturdy—it stands a lot of abuse.

It cuts without flashing—iron imbedded in concrete, through laps filled with dirt, in holes; jobs which the workman with the ordinary torch wants to dodge.

It operates with any gas under pressure—it uses acetylene, hydrogen or carbo hydrogen; simply necessary to have different tips.

It deserves and should receive your consideration.

Study the drawing on the opposite page and compare its qualities with the torch with which you are familiar.

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NO FLASHBACK
LOCKING DEVICE OPERATED WITH NO STRAIN
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This cutter we think embodies about everything desired by the user. Study it carefully. Its selling price with 4 nickel-copper, one-piece tips for hydrogen or acetylene, or carbo-hydrogen, is $45.00.

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Insurance, 2 per cent of $1,000	20	
Taxes, 1 per cent of $1,000	10	
Total for the year		$ 240
Rent	$ 35	
Heat	5	
Light	2	
Power	5	
Office expenses, etc	75	
Total for one month	$122	
Or for the year		1,464
Making a grand total for the year of		$1,704

Here we have a total overhead cost for one full year of $1,704. Calculating this as 3,000 working hours per year gives us an "hour cost" of approximately 60 cents. This must be added to the cost of every job handled in the shop. To find the total cost we must add such items as labor, gas, welding rods, etc.

Oxygen Consumption

First of all comes the oxygen. A simple method and one sufficiently correct for all practical purposes is all that is required. The high pressure indicating gauge on the regulator will tell very closely the number of cubic feet of oxygen used in welding, cutting or carbon burning.

If the graduation on the dial is in pounds, the cylinder will be full at 1,800. With a 100-foot cylinder, 18 pounds difference will represent one cubic foot; with a 150-foot cylinder, 13½ pounds; and with a 200-foot cylinder, 9 pounds. We may find out the cubical contents as follows:

Start	Finish	Used	Pounds To 1 Cubic Foot	Cubic Feet Used
1,800	1,200	600	18	33⅓

With a 200-foot cylinder the division, of course, will be by 9, and with a 150-foot tank, by 13½.

Dissolved Acetylene Consumption

The tank pressure indicating gauge on the dissolved acetylene cylinder cannot be used to figure contents since the gas is dissolved in a liquid, and the pressure varies according to the amount and purity of this liquid. The gas is more susceptible to temperature changes than oxygen, so the gauge reading on the acetylene regulator is merely helpful to record when the tank is becoming empty.

It is necessary with dissolved acetylene to find out the contents by weight, 14½ cubic feet weighing one pound. The cylinder may be weighed when received, and again when empty, and the difference multiplied by 14½ will give the cubical contents in feet. Since it would be impractical to weigh every cylinder at the start and finish of each job, some other more simple method must be used. The following gives a simple method, and one which will be close enough for all practical purposes.

To do this we ascertain the consumption of gases of the welding torch, and thereafter the cost record of gases may be kept by means of the oxygen gauge only.

Torch Consumption Test

All torches do not consume the same relative quantities of oxygen and acetylene, and the user can ascertain approximately the consumption of each gas in the ordinary run of work. Full cylinders of each gas should be used, and the acetylene cylinder, which should be a fairly large one, say, 225 or 300 feet, should be weighed before starting, and a record made of its weight. At normal temperature (about 65 degrees F.) the oxygen cylinder should register about 1,800 pounds. Then the apparatus is used in the shop on the usual work. When the oxygen tank is empty, disconnect the acetylene cylinder, weigh it, and ascertain the cubic feet of gas used, by the method already shown. It is possible that we have used 200 cubic feet of acetylene, or about that, but more likely it will be found that the acetylene consumption is less than the oxygen.

At any rate the ratio has been established, and if reasonable care has been used in the test, we will have a general idea of whether the torch consumes 10 feet of oxygen to 7 of acetylene, or 10 feet to 5, or whatever it may be, and thereafter we have only to determine the oxygen consumption by means of the high-pressure gauge, and estimate the acetylene consumption on the ratio established by the rest.

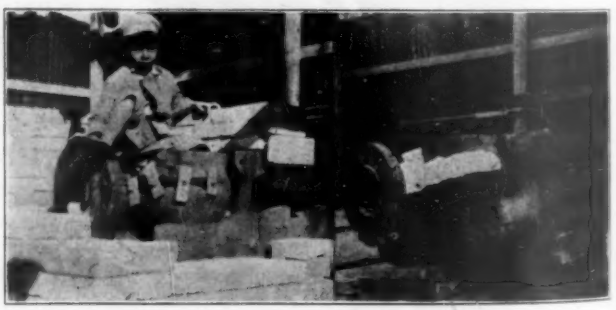
It must be understood, of course, that this test is not technically correct—the welding shop is not equipped to establish a test of this character, and the method described is simply one which will give a general idea of relative consumption.

Acetylene Generator Consumption

Establishing the number of cubic feet of gas delivered by the generator from a charge of carbide may be done by the aid of a meter; or in a general way, by first establishing the ratio of consumption of gases by the welding torch test just described—using dissolved acetylene, of course, to make the test—and then connecting the generator, freshly charged with a known quantity of carbide, and operating the torch until the generator is empty. As we already know the relative consumption of gases in the torch, we have simply to keep an accurate record of the oxygen used to find out how much acetylene we are getting per pound of carbide, and thereafter the cost record may be kept by means of the oxygen gauge as with dissolved acetylene.

WELDING A PUMP

Editor: The illustration I am sending you shows a weld on a pump. The casting weighs about 3,000 pounds. It had been welded before, but when put in operation a 6-inch crack opened up. This pump operates under 800 feet head and under this pressure the leak became so bad that the operation of the pump was out of the question. We put the pump



At Left—Ready to Weld. At Right—Completed Job.

under a crane and two Mexicans cut the old weld out and prepared the V. It will be noticed in the view at the left that they cut all the way through and some on the side, making quite a hole. This caused me to put a ¼ by 3-inch strap on the inside, which will be noticed in the view at the left. The cleats which will be noticed were for the purpose of holding the strap in place. The preheating was done with mesquit wood, for about twelve hours. The view at the left shows part of the furnace constructed. I first welded the strap at four different places, and then started at the end and welded towards the flange. It took four hours to weld and about 50 pounds of metal. At the right the finished job is shown. The pump has been in operation a month and the weld is holding.

J. E. Anderson.

Welding Fence Gate Frames with Armco Iron Welding Rods

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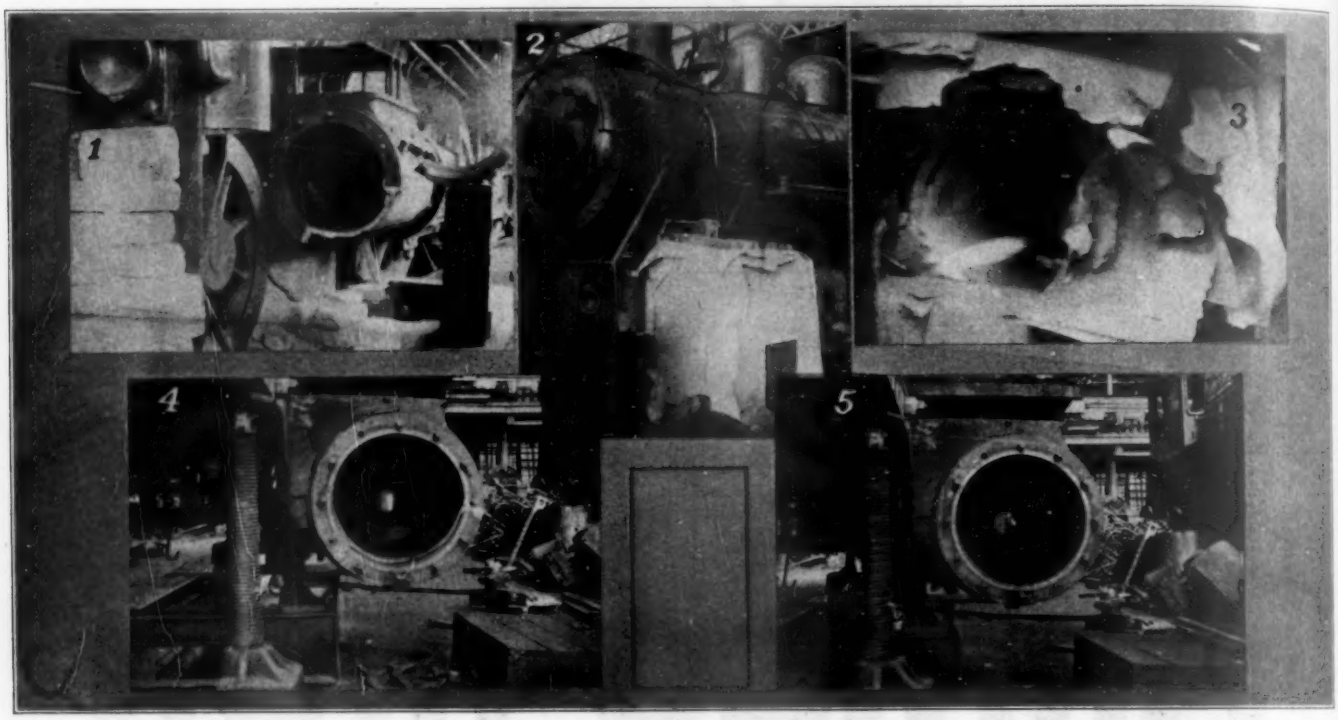
RAILROAD WORK

Editor: For the benefit of readers of The Welding Engineer, I am enclosing a few photos of work done in the railway shop here.

Photos 1, 2, 3, 4, and 5 are a series showing different stages of work in welding an engine cylinder in place.

No. 1 shows a piece broken out of cylinder (note piece on block at right) also the foundation of fireplace.

Having handled several broken cylinders, I know I can safely say that the largest factors of a successful job, are preheating and cooling. For no matter how much care is taken to make a clean, ductile weld, success is only a matter of chance if welding is started before the proper temperature has been reached, or if the cylinder is allowed to cool too quickly. Space will not allow me to mention the signs and symptoms, as it were, of these two important factors, which

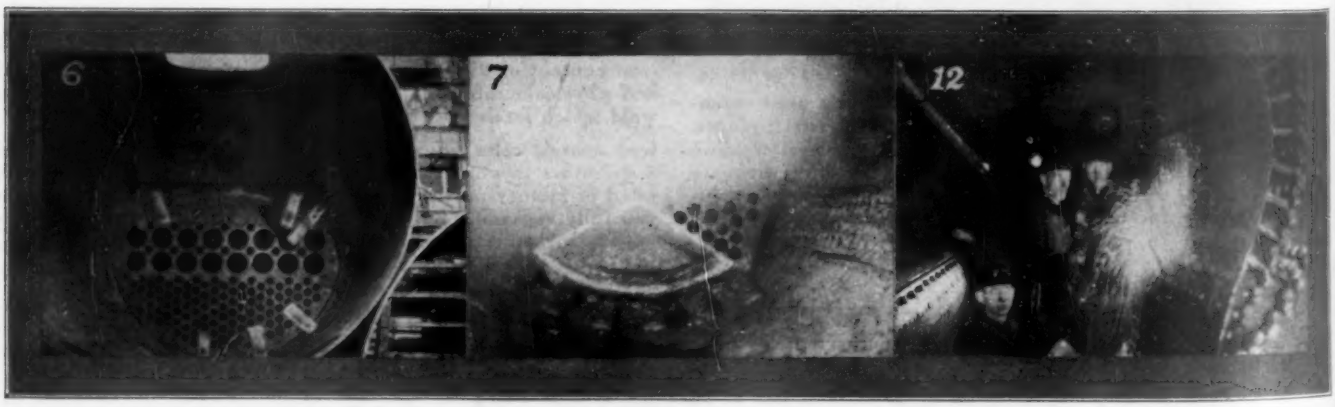


Various Stages of Locomotive Cylinder Welding.

In constructing the fireplace, a row of bricks are arranged on the floor, inside of which sand is placed as a precaution against fire. A few more layers of brick, then a grate is placed, sufficiently low enough to keep the bottom from becoming too hot, before the cylinder has reached the proper heat for welding.

have, from time to time, come to my notice.

Front tube sheet patch shown in No. 6 is set up ready for welding. It will be noticed that the top row of superheater holes have not been entirely cut out, this tends to prevent holes from becoming elongated. After welding is completed, holes are cut with pneumatic hammer and chisel.



Front and Back Tube Sheet Welding.

Bricks are then built up all around, far enough away from the cylinder wall to permit the heat passing evenly to all sections. The whole being covered with sheet asbestos as shown in No. 2. Charcoal is used as a preheating agent.

In No. 3, the cylinder is opened for welding, care being taken to exclude the air as much as possible.

The welded patch is shown in No. 4, and after machining appears as in No. 5.

Several back tube sheets have been renewed in the same manner.

Picture No. 7 while a little fogged, shows welded patch in center of back tube sheet. These patches are dished about $\frac{1}{8}$ inch which draws out when heated on completion of welding. The method of welding is to set patch with $\frac{1}{8}$-inch space along bottom and $\frac{3}{8}$-inch space on top. Starting to weld from center, down sides, starting again at bottom and

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finishing at apex.

The 200-ton capacity hydraulic press cylinder, shown in No. 8, is a much larger job than it looks. Owing to defects in casting this cylinder cracked, which when ready for welding was 22 inches long, 4 inches wide and 5½ inches deep. The photo was taken while it was under test at a pressure of 185 tons per square inch. Weld was entirely successful, not a leak showing in the weld.

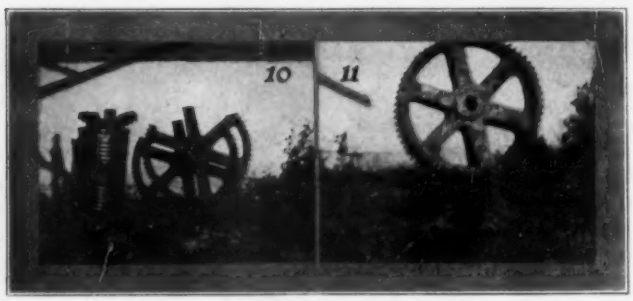
Picture No. 9, I consider the most interesting of all. Having received the impression from different sources, that bell

Fig. 8. Large Cylinder. **Fig. 9. Locomotive Bell.**

welding has been a failure, owing to loss of tone after welding. The writer has welded several bells, broken in different places. The result has been the same in all cases, tone completely restored. The bell shown in the photo was broken T shaped; welded with Tobin bronze, and good as new after machining.

The large cast iron gear wheel in No. 10 was broken in three places. No. 11 shows wheel after welding, which is now doing service.

No. 12 will not be new to railroad welders, but as it represents, ½ side sheet welding, and important part of the work done here, I am enclosing same.



A Cast Iron Wheel Job.

These few photos are but a peep into work done by the welding department here. The details as to how they were done, I have omitted for lack of space. However, I hope they will be the means of convincing skeptics as to the value of good welding and good welding equipment. Oxweld apparatus used here exclusively.

H. Dower.

Note: This work was done at Stratford, Ont.

The Farmers' Standard Carbide Co., Inc., Plattsburgh, N. Y,. has been in operation three months. The output is being sold to shareholders, practically all of whom are farmers. The plant is being remodeled and a new furnace will be installed, which will bring the output up to seventeen tons per day.

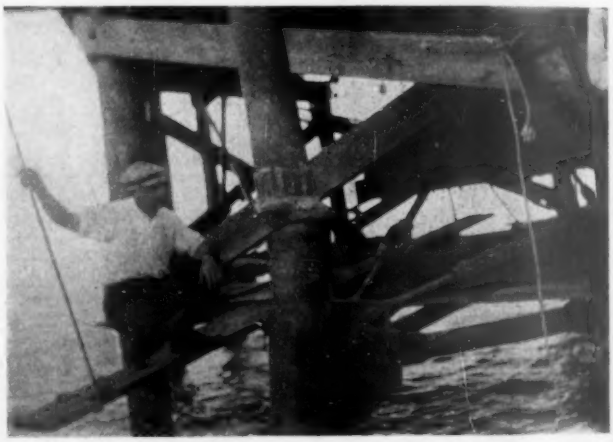
Mr. A. N. Mullen, of the Islands Welding & Supply Co., Honolulu, Hawaii, recently visited the trade in the United States.

STRENGTH OF THERMIT WELDED TIE RODS

The tie rods from a concrete ore dock back to an anchor wall were thermit welded by the Metal & Thermit Corp., 120 Broadway, New York, at the plant of the Algoma Steel Corp., Ltd., Sault Ste. Marie, Canada. A total of 39 welds were made in 13 pieces of 3¼-inch square rod, each rod being welded in three pieces. Before making these welds tests were made on a piece of 3¼-inch square bar which had been thermit welded, with the following results:

	Tensile Strength, Per Square Inch, In Pounds.	Elongation In Per Cent.
Original bar	48,560	52.5
No. 1—Thermit weld	27,500	2.5
No. 2—Thermit weld	52,200	6.0
No. 3—Thermit weld	44,880	4.0

The low value obtained in Test No. 1 is explained as being due to a slight pipe in the sample which considerably reduced its tensile strength. Test No. 2 was made on an almost perfect weld and tested stronger than the original bar.



An Unusual Lighthouse Repair. This broken column was welded by the Thermit process without aligning the column. See Jan. issue.

In preparing the sections for the tests, a piece of the 3¼-inch square rod 7 inches long containing the weld was cut out. This was put in a crank shaper and machined to flat surfaces on three sides, then put under power hack saw and quartered. Three of these quarters were then turned down to test pieces each having a cross sectional area of 0.7854 square inches or about 7½ per cent of the original bar. About 40 pounds or thermit was used to each weld and the preheating took about 2 hours to each weld.

A journeyman welder came to the institute to take instructions in advanced work. Before letting him join the class in advanced welding the instructor gave him some steel test bars to weld. Although beautifully welded they failed to show as high tensile strength as test bars welded by men in the beginner's class, who had used the torch only a few days. The explanation of the expert welder's failure is simple. He used a torch with a 75-degree angle head, and was careless in directing the flame into the vee so that both sides would be equally heated. One side received much more heat than the other and consequently penetration on the poorly heated side of the weld was indifferent. The metal adhered and pulled apart under a comparatively low tensile stress.—Autogenous Welding.

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Job Welding

THE foreman of a job welding shop in a large city informs us that there is a disposition on the part of large manufacturing concerns to train their own welders, rather than to depend entirely upon the neighboring job shop. He states that a large part of the work his shop received every year is not now coming in. In this particular city the larger shops derived the bulk of their patronage from the large industries.

Granting that this condition of affairs is true, it is but a further indication of the growth and importance of the art of welding. Big industries must keep the wheels going, and a good form of insurance is one or more competent welders. Job shops are not going out of business, by any means.

Making It Pay

EVERY once in awhile we hear of some fellow who started a job shop and failed to make it pay. There are four general reasons why a job welding shop fails to pay. It may be located in the wrong place, or the owner may not have sufficient capital. He may not be as good a welder as he thinks he is, or he may be a very good welder, but a poor business man. To make a success of a job welding plant the owner should possess all of the qualities mentioned. The shop certainly must be located where there is an opportunity to secure business. While many a successful shop has been started on a shoe string, a little money is desirable. Experience and skill must be a part of the qualifications of the owner. He cannot afford to guess wrong too often. He must be a business man and a business getter and a square fellow to do business with. Business will not come around and kick him on the shins—he must go after it. His costs and his charges will tell the story. That brings us up to the question of charge—how come?

What Shall I Charge?

AS a rule it is not at all difficult to induce readers of *The Welding Engineer* to express an opinion. Upon the question of how to charge for job welding work, however, we appear to have fired a blank. Or is it because our friends, the job welders, can't answer?

We are referring to an editorial published in the January issue, which read: "Upon what basis should the owner of a job welding shop make his charges? Should he charge on a basis of cost, plus a good profit, or should he charge all the traffic will bear? In other words, should he soak a customer when he thinks he can get away with it? Aside from good workmanship, what is the secret of success of the successful job welding shop? A friend tells us a successful and money-making shop can not be run on a cost-plus basis. He says the man who trys it will bust. Our friend thinks the percentage of failures, no matter how small, will upset the job welder's calculations and eat up his profits.

We don't think so. We believe that autogenous welding is a sound, legitimate business, and one which should be operated on clean, business-like lines. It's not good business to charge Smith any more for the same piece of work than you would charge Jones, unless perhaps, Smith was a garage owner and sent you a lot of work, in which case he is your jobber and entitled to a lower price. Of course, a great many people want you to give an estimate on a piece of work. They want to know in advance absolutely what the cost will be. In such a case, of course, the cost-plus plan won't work. But as a general rule, will the cost-plus idea work out? We would like to hear from our readers on this point. Our friend says 'there ain't no such animal.'"

THEODORE ROOSEVELT'S LAST WORDS*

I cannot be with you, and so all I can do is to wish you godspeed. There must be no sagging back in the fight for Americanism, merely because the war is over. There are plenty of persons who have already made the assertion that they believe the American people have a short memory and that they inted to revive all the foreign associations which most directly interfere with the complete Americanization of our people. Our principle in this matter should be absolutely simple. In the first place, we should insist that if the immigrant who comes here does in good faith become an American and assimilates himself to us he shall be treated on an exact equality with every one else, for it is an outrage to discriminate against any such man because of creed or birthplace or origin.

But this is predicated upon the man's becoming in very fact an American and nothing but an American. If he tries to keep segregated with men of his own origin and separated from the rest of America, then he is not doing his part as an American. There can be no divided allegiance here. Any man who says he is an American, but something else also, is not an American at all.

We have room for but one flag, the American flag, and this excludes the red flag, which symbolizes all wars against liberty and civilization just as much as it excludes any foreign flag of a nation to which we are hostile. We have room for but one language here, and that is the English language, for we intend to see that the crucible turns our people out as Americans, of American nationality, and not as dwellers in a polyglot boarding house, and we have room for but one soul loyalty, and that is loyalty to the American people.

**Read at the All-American Festival in New York.*

Yours for welding.—Mackenzie.

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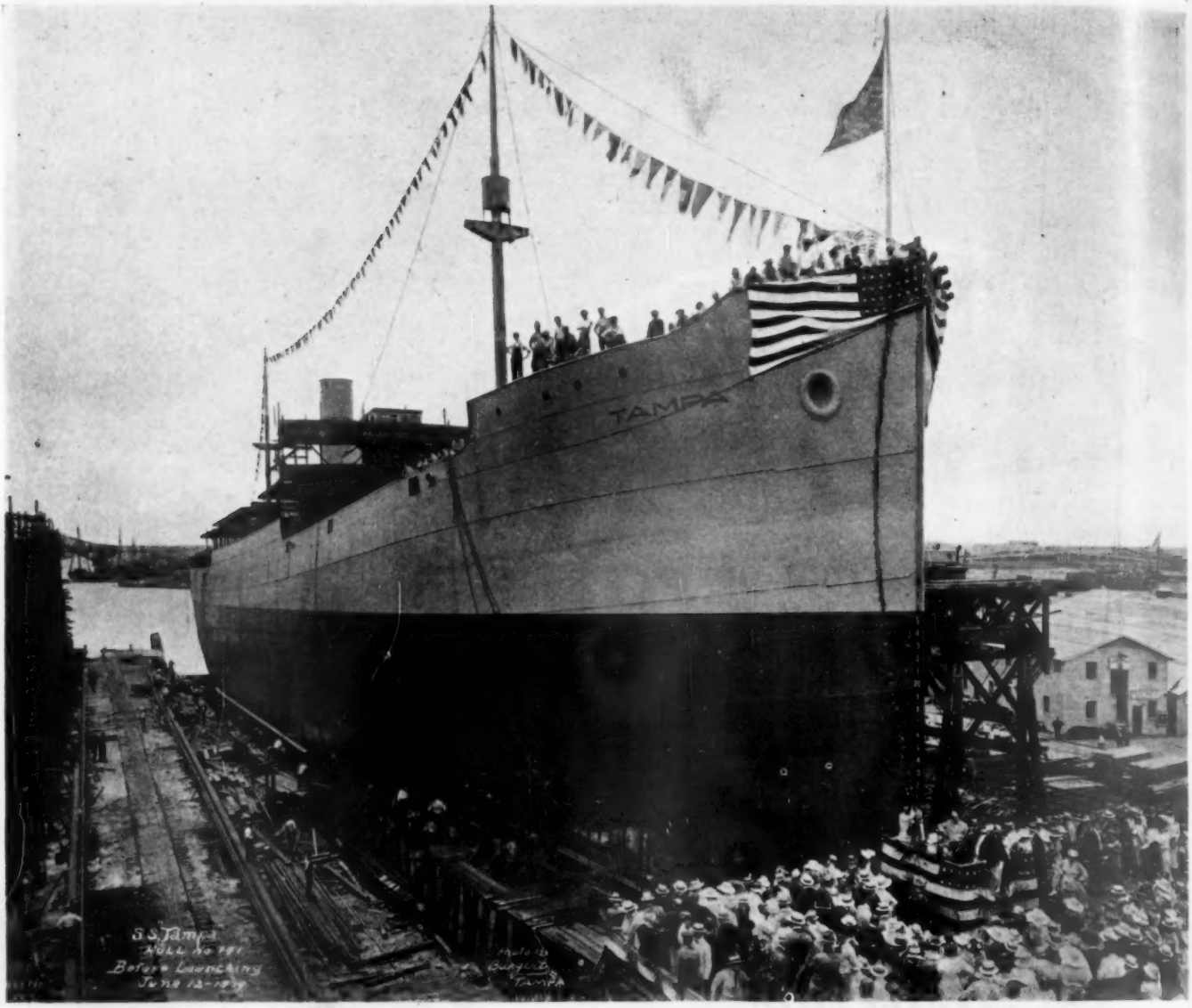

S. S. Tampa, Built by the Oscar Daniels Ship Building Co., Tampa. There was plenty of welding on this vessel.

WELDING SHIPS AT TAMPA

An enviable record, both during the war and since, has been made by the Oscar Daniels Ship Building Company of Tampa, Fla. Not only has this company applied the process of oxy-acetylene welding to ship construction with great success, but it is also said that the class of work being done in this yard is unusually good and above the average.

During the war the company contracted to build ten big cargo carrying vessels, such as the S. S. Tampa, which is illustrated herewith. Five have been completed, five remaining incomplete.

About 45 men are kept busy in the welding and cutting department of this plant.

The accompanying illustration shows the interior of the gas compressing room. There are two 200 pound Davis-Bournonville Generators, Gasometer, Purifier, Driers and Compressor charging seven 225 cubic foot at a time, giving each lot of tanks two charges. After the water passes through the compressor, it is lead through a 1½-inch pipe to tanks through a spray which keeps tanks cool while compressing.

A view is shown of the welding shop where some stunts are now being accomplished with the cutting and welding torch on angle smith work. The pieces are first laid off and punched, and then offset with the torch as shown, "V" all joints with cutting torch, apply to slab with square holes, dog to lines of template and weld in that position. They are ready then to go to the boat and all holes come fair. This view shows one of the hardest propositions in angle smith work. All persons familiar with this class of work can see the difficult points. This staple is for the shaft alley, margin plate, shell plate and after tank. Top made complete with torch of 6-inch by 6-inch by ½ angle and when put up by ship fitter. Slip in as if molded. All welds are hammered.

(*See Pages 46 and 48 for illustrations.*)

An illustration is shown of a floor plate. Holes 17 inches diameter half-inch steel plates. The man to left, A. S. Portens, made some speed cutting these circles—all clean cuts. He cut 18 circles in 55 minutes equal to 954 inches or 17 inches per minute, with a Davis-Bournonville circle torch. The slots are also cut with a torch. There are 35 cutters, all fast and clean cutters. Each man has a complete outfit and large tool box. Tanks are kept on upper decks. Each man has 85 feet of hose, with a 10-foot very flexible hose for a lead.

There are four first-class welders. Before employing a welder, they try him out. If he can deliver the goods, they employ him.

A test of a welded specimen was made not long ago, two pieces 2 inches by 9 inches by ¼-inch steel plate. The pieces were bent cold until the ends met at 180 degrees. The Government requirement is 90 degrees. Later these same pieces were hammered flat, no defects showing in the weld.

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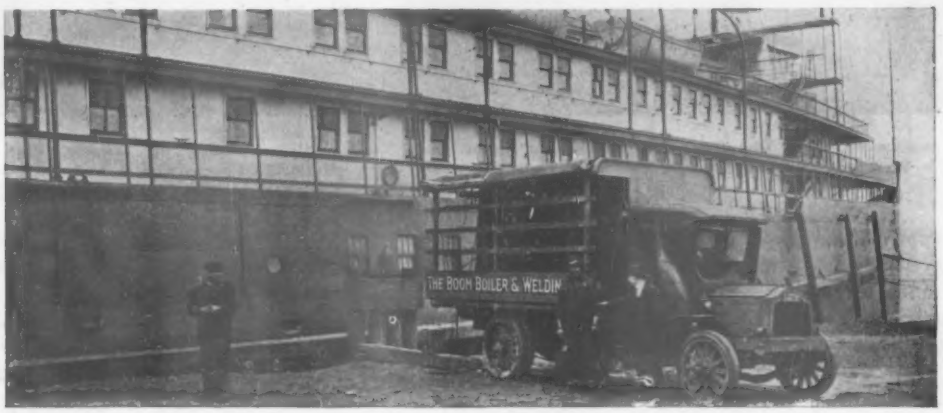


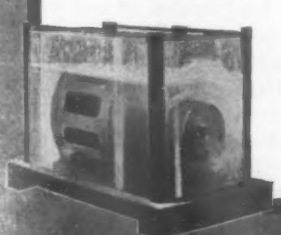
Electric arc welding outfit mounted on motor truck. This outfit is the property of The Boom Boiler & Welding Co., Cleveland, Ohio, and is doing repair work on the "Seeandbee", the largest passenger steamer on the great lakes. The equipment consists of a 35 H. P. Novo Engine belt connected to a 150 ampere Lincoln Arc Welder. The engine also operates an air compressor for operating a pneumatic hammer. The cable which carries the welding current can be seen entering the ship through the opening in the side.

This outfit enabled its owner to secure $15,000.00 worth of welding business which he otherwise could not have handled. Even then, it was not working all the time.

Wouldn't $15,000.00 more business help you, too?

Write for Bulletin 104-W

This standard Lincoln Motor operated over 3 years under water without damage.



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Continued From Page 24.

job. The flux is carried to the work, which should be at the melting-point and introduced between the flame and the metal. Oxides will break up immediately and the metal will flow together, but it must be remembered that the flux has no action on cold or moderately heated metals. The flux as has been explained is used to clean the metal and break up the oxides. To the oft-repeated question, how often should the flux be applied, answer is made as follows: As often as it is necessary to clean up the metal and break up the oxides. All fluxes should be kept in airtight containers when not in use, to keep their chemical contents in the very best condition and it is best to use only a small quantity of flux on the welding table at one time.

As we stated before, oxy-acetylene welding is purely a fusing process and the most important points to remember in executing a weld are, to eliminate the entire crack in the fracture and to add the filler-rod without changing the character of the metal. On thin pieces of metal it is possible to depend upon the force of the flame to entirely penetrate to the depth of the crack but on work three-eighths of an inch thick or over, it is well to "V" out or remove some of the surface metal around the crack in order to get down to the bottom. By "V-ing" we mean to chip or grind off each edge at an angle of approximately 45 degrees, so that the opening will form an angle of 90 degrees where the two pieces come together, with the crack at the bottom portion of the "V." This should not be ground down to a knife edge, for it will readily burn up. It is preferable to leave about one-eighth inch along the line in order that the pieces will fit together and the proper alignment may be obtained. If two pieces of cast iron have been prepared in this manner the neutral flame of the welding torch is brought down in such a manner that the tip of the cone just licks the metal. The heat is not applied directly to the line of weld to start with, but rather to the surrounding part. This is done in order to get the entire locality in a condition which will not withdraw too much of the heat from the line of the weld, once the fusing is begun. If it is found that the tip will not produce enough heat to bring the metal to a red heat in a fairly short time, a larger tip should be used.

The 359-lb. gentleman is Mr. Chas. Roberts, Purchasing Agent, Oscar Daniels Ship Building Co., Tampa, Fla. The man with the torch is Wm. McDonald, one of the best welders in the plant. G. C. McCarty, Foreman of Acetylene Dept., is at right. Illustrations and information by his courtesy.

Gas Compressing Room, Oscar Daniels Ship Building Co., Tampa, Fla.

No set rule can be given as to the sized tip to be used on various kinds of metal. It will largely depend upon the welder's ability and judgment. When the metal is brought to red-heat, the neutral flame or cone is brought into contact with the lowest portion of the "V" and held there until it is seen that the metal is melted on both sides. The filler-rod, which has previously been heated at one end and dipped into the flux so that an amount adheres to the end of the rod, then carries this flux to that portion of the weld which is under way. Enough flux is blown off the rod into the weld to clean up the surface and permit the metal flowing together. The crack should be melted together all along before any additional metal is added, for the elimination of the crack is extremely important. It might be noted that as soon as the metal begins to flow freely the neutral flame should be raised a short distance from the work in order to better control the molten metal. In order to build up the

Floor Plate with 17-in. Hole. Man at left, A. S. Portens, cut 18 circles in 55 minutes—all clean cuts—with a D-B circle torch. (Oscar Daniels' Plant.)

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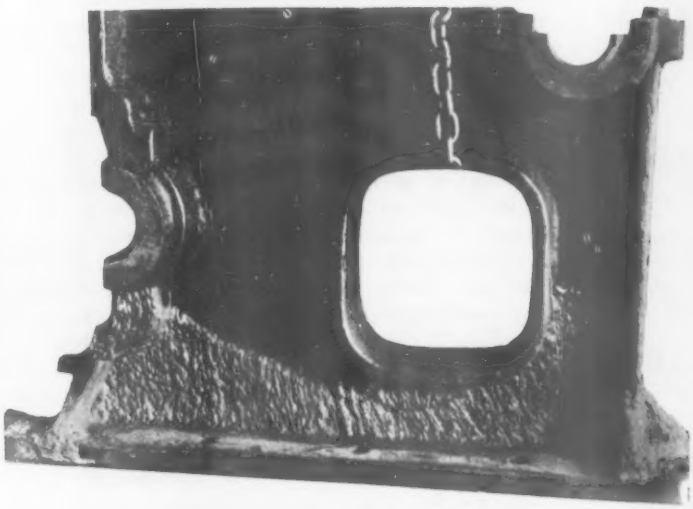


ELECTRIC ARC WELDING of $\frac{1}{2}$" thick and heavier plate steel costs with current at 1c per K.W.H., $2\frac{1}{2}$c per hour. Gas per hour, $2.50. Electrodes and labor the same in both cases.

In the above comparison we have put production work. While such a comparison is favorable to gas methods, we have experiences from our customers that one electric A. C. arc replaces at least two and generally three or four gas torches. We have a voluntary statement from a gentleman high in the gas welding field that there are not twenty-four gas Welders in the United States that he would trust on steel plate of over $\frac{3}{4}$" thick, and he also stated that electric arc welding was not difficult to do correctly on thick work, even up to 12" thick. Added to the saving, which is greater the larger the job, is the saving due to no need of preheating in many cases, and the many, many places where electric welding can be used where gas can not, or under great difficulty be used, such as boiler and flue welding, overhead and vertical jobs, etc.

We will not run gas welding out of your job shop, but we will lower costs on many jobs and broaden your field.

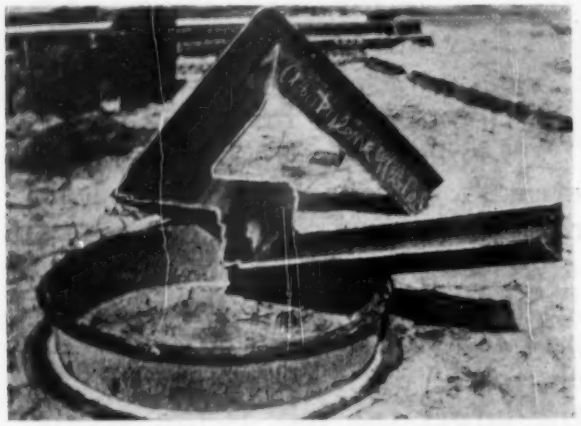
Our Catalog No. 38 will reveal surprising facts on welding

ELECTRIC ARC CUTTING & WELDING COMPANY

222 Halsey Street **Newark, N. J.**

metal to the original state along the line of weld or perhaps reinforce it, the sides and bottom of this "V-ed" out part are then brought to a molten state and held there while the filler-rod which brings up more flux is stirred into this metal and the end melted off. In this way the flame does not come in direct contact with the filler-rod and is used only to keep the metal in a molten condition. As much of the filler-rod can be melted off as is thought necessary to bring the weld to the normal condition of the metal or an additional reinforcement can be built up, if it is thought advisable. If care is taken in the above procedure, many of the blow holes and hard spots in the weld will be eliminated, for any impurities that might gather will be displaced by the melted metal and will float to the top. In cooling a weld of this kind, care should be taken not to permit any sudden chilling for this will tend to harden the weld. It is best to cool it slowly by burying it in slack lime, ashes, or wrap it with asbestos paper to keep the air from it as much as possible.

There may be a great many causes for blow holes and hard spots in the weld, but probably they can all be traced directly to the lack of heat. It must be remembered that welding is a fusing process and heat is absolutely essential. Therefore, it should not be used sparingly. Welders who would not think of throwing a cast iron weld into cold water for fear of chilling the metal can often be found lining up



One of the Hardest Propositions in Angle Smith Work. Made complete with torch at Tampa. See Page 44.

their work on large metal slabs or face plates and making the weld in this position. The large body of metal conducts the heat away from the weld and cools it very rapidly causing it to be chilled, and there is no wonder why the weld is hard and brittle if this method is used.

The application of heat always caused expansion. There are no exceptions to this rule, likewise upon cooling the metal there will be a contraction. Outside of the actual welding, that is, the fusing of the metal into a homogeneous mass, perhaps the greatest problem that the welder has to confront is the expansion and contraction of his metals. Whenever the ends of two pieces of metal which are to be welded are free to move, or even one end, there will be no difficulty encountered with contraction and expansion, but if those ends are continued, it is an entirely different problem. In the latter instance, preheating is necessary to reduce the expansion to a minimum when the welding flame is applied. Whether the entire piece is to be preheated, or only one number, depends largely upon the nature of the work.

In the case of repairs the matter of costs plays a very important part. Many times the cost is a very small matter, but in other instances may exceed the cost of a replacement part. But if no part is available it may be worth while to weld it. In computing costs, conditions will naturally vary in different shops. In some cases where the parts are heavy they will be preheated and naturally will require less gas and time to weld them if they had not been so treated. The time of the welder, the amount of gas and material used, added to the overhead, forms a basis for figuring costs. The amount of gas used on each job where individual cylinders are used can be determined from the gauge on the oxygen regulator, if a chart is obtained from the manufacturers of the apparatus showing the ratio of the oxygen consumption to that of the acetylene. This ratio varies for apparatus of different types.

In acetylene cylinders an absorbent called acetone is generally used, which gives up the gas as required. A full cylinder can be used for some time without any noticeable difference in the gauge reading and then, as it nears the empty point, the gauge reading will drop very preceptibly. It is therefore impossible to depend upon a high-pressure acetylene gauge as an index to the contents of the cylinder. The only method known to correctly check the amount of acetylene gas on hand is to weigh the cylinder. There are 14½ cubic feet of acetylene gas to the pound, and when the net weight of the cylinder is given the contents can readily be figured. A tag bearing the net weight or figures which will permit this computation is generally found attached to each acetylene cylinder. In the case of oxygen cylinders, there being no absorbent used, the contents of the cylinder is indicated on the high-pressure gauge. On the latest type gauge the contents will be shown by cubic feet, by pounds pressure and by atmospheric pressure, to facilitate the computation of costs by the operator.

It may appear strange that so much emphasis has been made upon "fusion" in this talk on repairing, but really this is the keynote for successful welding, and without it, permanent repairs cannot be anticipated. The method of testing the operator's skill which we have referred to is quite a simple matter, yet one which is overlooked and has been the cause of much careless and ignorant applications in the oxy-acetylene industry. During the world's war we were called upon by the Ordnance Department of the army to establish schools and train welders for the various departments of the service. During this time, approximately 2,000 men were trained, averaging about 20 test welds per student. Schools before commercial welding was permitted. In personally inspecting these 40,000 odd test welds a very good idea was obtained as to the ability of the operators, which composed the classes, many of which were men who had had considerable experience in civilian life. It is with this condition still in mind that we are trying so hard to emphasize the importance of through fusion. With proper training the results are most gratifying and it certainly behooves those dealing with, and depending upon, machinery and metal parts today, to give due time and consideration to the oxy-acetylene welding process and the operators who are called upon to do the work.

MANGANESE WELDING RODS

For some time past the Electric Arc Cutting & Welding Co., 222 Halsey Street, Newark, N. J., has been marketing manganese steel welding rods. These rods sell at 45 cents per pound and have a manganese content of 12 to 14 per cent manganese.

In the advertisement of the Electrolabs Co., in the January issue of *The Welding Engineer* several errors occurred in the captions under the illustrations. Attention is directed to the corrections which appear in the same advertisement on page 55 of this issue.

ANGLE OF VEE

The generally accepted rule for beveling the edges of pieces to be welded is to cut each side at an angle of 45 degrees, thus making the included angle of the groove about 90 degrees. It would be incorrect, however, to state that the angle should be invariably 90 degrees, without qualification. While it is true that the 90-degree angle gives the best average results, and the welder should always aim to maintain this angle at the point of fusion and welding, this does not necessarily mean that, when preparing a heavy broken casting the included angle should be 90 degrees from the bottom up. On the contrary, it would be a mistake to bevel the edges of a casting 4 inches thick so as to produce a 90-degree groove throughout. It would mean waste of gas, adding material and time, and no better result than could be produced if the sides were cut at an angle of, say 30 degrees, thus producing an included angle of 60 degrees. The bottom of the vee can be maintained at the proper welding angle very readily and all the advantages of the 90-degree groove secured. A curved effect is even better, as the sides can then be made practically parallel at and near the top. So long as there is room in the groove for the welder to manipulate the torch and to see what he is doing, that is sufficient. The rule then should be to cut the bevel with the object of providing sufficient room for manipulating the torch, and no more. The rule providing a 90-degree angle for the groove applies correctly only in comparatively thin metal when the thickness is not sufficient to warrant any great amount of trouble being taken in beveling the sides to save metal.—Autogenous Welding.

WESTINGHOUSE CIRCULAR ON ELECTRIC ARC WELDING.

The Westinghouse Company has just recently issued quite an elaborate publication covering the process of Electric Arc welding, and the necessary apparatus required for this process. This publication compares the different processes of welding, such as Autogenous welding, Forge welding, Oxy-Acetylene welding, Thermit welding, and shows the advantages of Electric Arc welding over these.

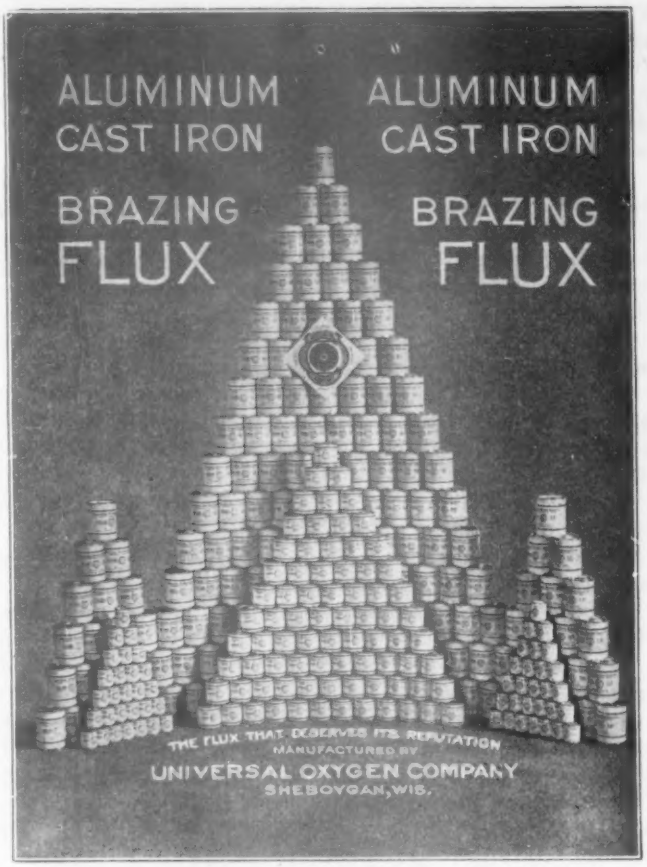
Some of the advantages of Electric Arc Welding Shows are:

1—Economy.
2—Ease and convenience of application.
3—Speed of operation.
4—Reliability of results.
5—Reclaiming defective material.
6—Safety.
7—Conservation of material.
9—Less skilled labor required.

The field for Electric Arc Welding is unlimited, and the process has made enormous strides during the last few years, until now it is widely used throughout those branches of the metal industry in which work is done on iron or steel in rolled, cast or fabricated forms. New fields for its successful application are being discovered every day.

The International Oxygen Company with main offices at Newark, New Jersey is establishing a new branch plant at Toledo, Ohio to furnish Oxygen and Hydrogen for all purposes to the numerous manufacturers and industries in that busy industrial section using either one or both of these gases in their processes.

The capacity of the plant will be 3,000,000 cu. ft. of gas per month the purity of which will be 99.5 per cent and higher. Over two hundred I. O. C. system Oxygen Hydrogen Generating plants are now in operation not only in the United States but in practically every foreign country as well and the Toledo plant when completed will be the finest of its kind in existence.



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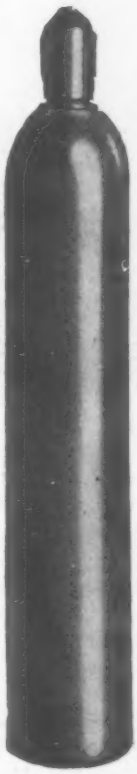

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STAMPING PRESS FRAME

Editor: Having noted in The January Welding Engineer the Press Frame that was welded successfully, during the war I am sending you photos of a 400 lb. Cast Iron Stamping press frame, that to me is unusual in many respects and inasmuch as I welded it myself, I am so blowed up over it that I feel as though I am entitled to use that much abused term of expert welder.

This frame had one shaft bearing broken off completely, and as is usually the case the owners wanted it back at once, and a guarantee that it would not break again. I welded it, guaranteed it, and today it came back broken but not through my weld, not alongside of it, but on the other side of the machine altogether.

Can you blame me for feeling gay and sitting right down to tell you all about it, and sending you the photos, I am immensely proud of that job, for the reason that it was the first job done by yours truly, for himself and because today I have something real to show people, that welding is reliable and will stand up.

The first unusual feature is, that the job was done cold behind the client's place of business.

The second is that it was returned to service without any machining being required on the shaft way, in 18 hours.

Again there was no reinforcement, above the original surface of the casting.

To me it gives satisfaction, in knowing, that the machine stood up under constant service in the last six months, that my weld was not the weakest point of the casting, that it withstood the strain and gave out somewhere else, as the other photo will show, and the third shows the completed job before painting. The second time it was returned in 48 hours, and I am satisfied it will stand up now as well as it did in the last six months.

The job was handled in this way the first time. A 90 degree V was chipped all the way round the outside except for four

Two Examples of Good Welding.

points of contact, the inside could not be touched on account of a "I" guide way. A, C-clamp held the broken head in place until I had dug in from the outside to about ⅛ of an inch of the guide way, then a strong tack weld was made, when cool the clamp removed, and the shaft put in place and the shaft caps put on, and screwed on, this for the purpose of keeping the alignment, and it done the work better than expected. The job was finished up, with the sun as my preheating torch and a No. 11 D-B Tap and torch.

The second photo will show the new crack or break, the same V-ing out. It was preheated until the proper expansion was secured, with the cracked side up, after welding this side, it was turned over again heated, the inside finished, again preheated and allowed to cool off weld down and is now back in service.

Enclosed you will also find photos of another Stamping Press, frame that had been welded before and sent to my shop for rewelding. It had broken through the other man's weld. The

Typical Fire Brick Furnace.

last photo will show you my method of welding it so as to not have a chance of the other man's weld affecting my work, providing reinforcement both in and outside.

I have welded about 8 Press Frames in the last 6 months, all are standing up but these are the only two that I think might interest you.

A. F. MORTON.

Editor's Note: Mr. Morton is one of the boys who went "over there" and helped to put a perfectly good war on the bum. He is building up a business for himself now and we wish him luck.

We wish to again point out the fact that welds which have been made cold do not necessarily break in or near the weld. Because of this fact welders are often led to believe that the laws of contraction and expansion may occasionally be disregarded. Many a welded object contains internal strains from this cause, and never breaks, and in such cases the welder is fortunate indeed. However, in the case of Mr. Morton's press frame the break on the opposite side may have resulted from the structural weakness in the design of the frame. He was on the ground and should know.—L. B. M.

ELIMINATING OXIDE

A reader asks our opinion as to the best method of eliminating oxide from an arc weld, suggesting that possibly the oxide might be floated out.

In our opinion there is no method of floating the oxide complete out of the weld using the metal electrode process of electric welding. Where only one layer of welded material is to be added to the pieces it is not necessary to remove the oxide with scratch brush or sand blast, but where several layers are to be applied, one on top of the other, it is certainly advisable to remove the outside as much as possible.

One way of assuring clean metal on the top of the bead is to use some kind of a covering on the electrode which has sodium silicate in it, something like Mr. Wanamaker's electrode, so that the scale can be chipped off of the welded material very easily. In this practice the welded material is left very clean having a surface which appears very much as if the metal were nickel plated. For ordinary purposes, however, when two or three layers are to be applied, the scratch brush, which is nothing more or less than a steel casting brush, is sufficient to remove the oxide.

In regard to welding galvanized iron wish to advise that we have never found this practice commercial or practicable.

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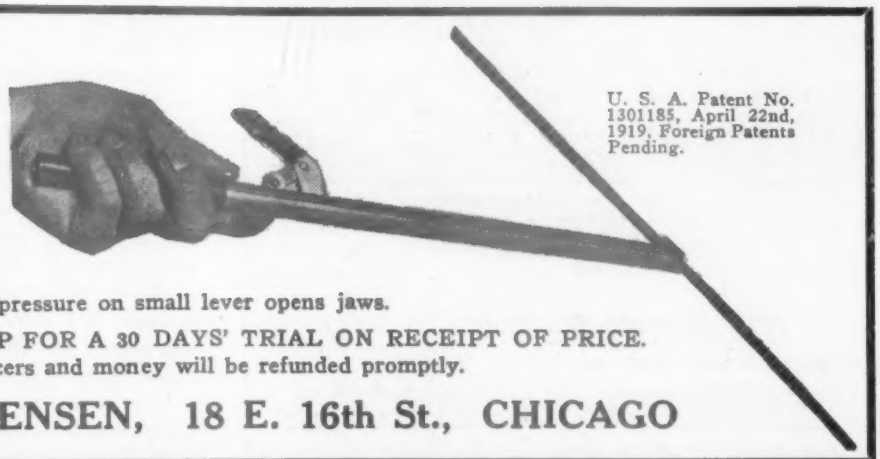

U. S. A. Patent No. 1301185, April 22nd, 1919. Foreign Patents Pending.

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Campbell's "Oxy-Acetylene" Welding Manual

By Lieutenant Lorn Campbell, Jr.
Ordnance Corps, U. S. A.

Lieut. Campbell organized and conducted the Army Welding School at Peoria, Ill. His new manual is based on his experience there, in training soldier welders. 154 pages, 89 illustrations, bound in cloth, $1.25.

THE WELDING ENGINEER
Chicago, Ill.
608 S. Dearborn St.,

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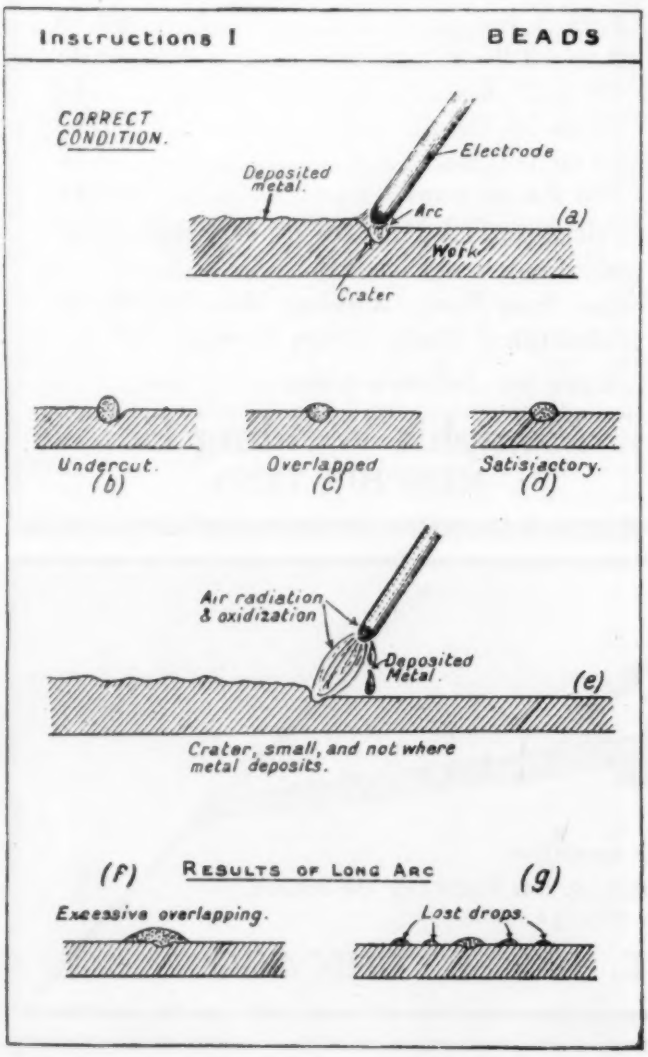
INSTRUCTIONS IN ELECTRIC ARC WELDING* BEADS

1. The electrode must be held close to the work, *i. e.*, a close arc for successful welding. The natural tendency is to draw a long arc, but in this case too much of the heat is lost by air radiation and there is too great an area for oxidation of the metal in passing from the electrode to the work, and there is too great an area provided for the air to get in and form oxide and nitride, both of which are very undesirable impurities in the weld. (See Fig. E.) There is a further chance with a long arc that the electrode material will not be deposited in the parent metal made fluid by the arc, but spattered outside or overlapping, in which case no weld results. (See Figs. F and G.)

2. As shown in Fig. A, the electrode material must pass



into the crater or fluid bowl of the work made by the arc, and the electrode must be held in such a position that the metal can pass nowhere but in to this fluid bowl.

3. The fluid bowl only appears at the point the arc strikes, and the arc must be kept striking just ahead of the deposited metal partially in the parent metal or, to say it in another way, the arc must be kept at the advancing edge of the puddle; if the arc is allowed to draw back on the bead simply a bridge of metal welded from the weld to the point where the arc next strikes the parent metal will result. This exercise should be made with both flux-coated wire and bare wire. It will be noted that with flux-coated wire with the bare side advancing as it is designed, the flux-coating will follow along covering the molten puddle and preventing the arc backing up on the weld providing a close arc is held.

To get the correct rate of heat for any given condition of electrodes or work, the following test should be applied, and it is the best, in fact the only test yet devised. Run a bead and note whether the edges are undercut as at B, overlapped as at C, or perfect as at D. If they are slightly undercut it can be told by looking at the bead, but the perfect weld and the overlapped weld can only be told by chipping off the bead. Different electrodes melt at different rates of heat, and different kinds of parent metals show small or large fluid bowls or craters, depending on their make-up, so that even with the correct length arc this test should be applied for each new condition. The undercut, in general, results from a larger bowl than electrode deposited to fill it, and the overlap bead may result from this or from a long arc, where the bowl is made smaller, in fact, with an arc over ½ inch long with certain current densities the bowl may disappear entirely, showing results as at F, G and E, which also show the effect of a long arc. On the A.C. welding machine and on some D.C. machines there is provision for limiting the length of the arc, but whereas penetration or some other desirable quality is lost when limiting arc on D.C., on A.C. no desirable qualities are lost.

The bead should be run until proficient with the three main different styles of electrodes, *i. e.*, the completely coated electrode in which the arc exists inside of a viscous tub deposited at the same rate as the electrode, the idea being to keep the oxygen and nitrogen of the air from combining with the steel when molten and when it has its greatest chemical affinity. With this electrode a slag is left around and on top of the weld, which must be chipped off for a clean start if the arc should happen to go out or in restarting to continue the bead.

With the flux-coated electrode, bare side advancing, it will be noted that there is no danger of dross inclusion and that the dross can be brushed off, and that in restarting there is no need for chipping the weld clean. The best way of cleaning the weld is by the same action which brings the dross to the surface, viz., the coating on the electrode, which, under the heat of the arc, floats the undesirable impurities to the surface. With bare wire there is naturally no danger of slag inclusion, but a harmful amount of the oxide and nitride of the iron are included, as the time for bringing them to the surface, *i. e.*, while the metal is molten, is too short to allow them to disentangle and come to the surface. It is not practical to run slag-coated electrodes as a narrow bead because a spreading action is necessary to keep slag out of the weld.

After proficiency in running beads horizontally is attained, the beads should be run on a vertical surface from the bottom up. Here it will be noted a close arc must be held or metal will run away. The next step is to run the beads horizontally on the vertical surface, and lastly from the top down. By this time a close arc will be so natural that overhead welding can be attempted, but if not successful no worry need result, as it will come naturally in time. The most important things to be learned in runnig beads are:

1. Close arc, *i. e.*, not so close as to stop arc, but close enough to produce a crackling noise and not far enough to spatter metal about.

2. Keep the arc at the advancing edge of the puddle. Beads are used commercially to seal cracks, caulking edges, and as the first layer in butt and fillet welding for ductility.

It will be noted by operator that with a correct length of arc the metal passes across as an invisible gas or vapour, but if drops of metal appear at end of electrode, the electrode is being held too far away, or hearing conditions are not correct.

**Instruction No. 1, from the handbook of the Electric Arc Cutting & Welding Co., 222 Halsey St., Newark, N. J. Copies of the complete instruction book may be had from this company at $1.25 each.*

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AUTHORIZED LICENSEES

Akron, Ohio—Akron Welding Co., Sweitzer Ave.
Augusta, Ga.—Southern Welding Co., 927 Ellis St.
Bloomington, Ill.—Keiser-Vanleer Co., 211 E. Market St.
Birmingham, Ala.—W. T. Sanborn Co., 10th Ave.-19th St.
Bridgeport, Conn.—United Welding & Repair Co., 172 Elm St.
Brockton, Mass.—Cushing Bros., 29 Chestnut St., E.
Cedar Rapids, Iowa—Otto J. Jirsa, 1328 L St.
Columbus, Ohio—Central Ohio Welding Co., 200 East Lynn St.
Des Moines, Iowa—Bernhard & Turner Auto Co.
Charlotte, N. C.—U. A. Rutledge.
Denver, Colo.—Blanchette Welding Co., 149 South Broadway.
Erie, Pa.—Lake Erie Welding & Spring Co., 338 W. 12th St.
Eustis, Fla.—M. Hopson.
Evansville, Ind.—Lindenschmidt Co., Ingle St.—1st to 2nd Aves.
Fort Wayne, Ind.—Motor Truck Sales Co., 327 E. Wayne St.
Galesburg, Ill.—Galesburg Machine Works.
Grand Rapids, Mich.—Ox-Welding Company, 75 Sheldon Ave.
Harrisburg, Pa.—Harrisburg Welding Co., 94 S. Cameron St.
Hudson, N. Y.—Hudson Welding & Repair Wks., 22 Spring St.
Jacksonville, Fla.—M. Mock, Jr.
Kansas City, Mo.—General Auto Parts Co., 1621 Grand Ave.
Lincoln, Neb.—Lincoln Motor Car Co. Cor. Q and 12th Sts.
Lima, Ohio—Buckeye Welding & Repair Shop, 133 Water St.
Louisville, Ky.—Southern Motors Co., 615 Third Ave.
Memphis, Tenn.—J. B. Cook Auto Co., 294 Washington
New Orleans, La.—Scored Cylinder Repair Wks.
New Haven, Conn.—New Haven Welding Co., 763 State St.
Pensacola, Fla.—East Hill Garage, 1501 E. Blount St.
Portland, Me.—Portland Garage Co., 49 Cross St.
Providence, R. I.—Rhode Island Score Filling Co., 173 Eddy
Raleigh, N. C.—Republic Service Co., 108 S. Blount St.
Richmond, Va.—F. D. Schluter Auto, 1009 W. Broad St.
St. Louis, Mo.—Scored Cylinder Wks., 325 N. Jefferson Ave.
Savannah, Ga.—H. W. Smith, Bay & Price Sts.
Schenectady, N. Y.—Franken Welding Co., 5 Villa Rd.
Shreveport, La.—The Bain-Braird Welding Co.
Springfield, Mass.—Hoag Welding Co., 31 E. Court St.
Springfield, Ill.—Romie Fields, 317 South Third St.
Troy, N. Y.—Reliable Auto Repair Shop, 229 River St.
Tampa, Fla.—R. G. Wood.
Washington, D. C.—Day Welding Co., 43 Summer, N. W.
Worcester, Mass.—Central Welding Mfg. Co., 98 Union St.
Yonkers, N. Y.—Kipfer Engineering Co., 11 Nepperhan St.
Youngstown, Ohio—C. F. Erb, 722 Madison Ave.
Montreal, Canada—Pyke Motor & Yacht Co., 374 Notre Dame
Regina, Sask., Canada—Capital Welding Shop, 1762 Osler St.
Toronto, Canada—Ontario Motor Car Co., Ltd., 18 Bloor St.,
Windsor, Canada—L. Lawrence & Co., 41 Sandwich St., W.
Melbourne, Australia—A. Finlay Bros., 322 Elizabeth St.
London, England—New Welding Co., 26 Rosebury Ave., E.C.I.

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A FEW TERRITORIES STILL OPEN FOR LICENSEES

Recently a welder in a job shop told me a man couldn't stay in the business for two years without accumulating a perpetual grouch. There is possibly a good reason for that—why not stick a smile sign over your welding table: "A Smile Wins a Pile." There isn't a person in the world who had not rather do business with a man who constantly radiates cheerfulness than one who looks as though he had just swallowed a green persimmon. I am not agreeing that the welding business germinates the grouch bug. I do believe that most people who bring a welding job into a shop invariably feel they are being stung when they pay the bill and it is apt to create anything except a kindly sentiment. However, you get what you ask for the work and the customer will be perfectly satisfied later when he finds the job holds up and gives the service desired.

The average person has absolutely no conception as to the time consumed in preparing the job for welding or the welding itself and the other incidental costs. He brought you something of practically no value in its broken condition—he gets the same piece or pieces returned just stuck together, as he sees it. It is invariably unwrapped, unsightly and cumbersome to carry. Topping it all off, comes your cold-blooded: "A dollar and a half, please." You should sort of

---

The Metal & Thermit Corporation, New York, N. Y., has issued and will distribute on request a large 1920 map calendar showing railroad time zones in the United States and Canada; also showing illustrations of interesting Thermit welding jobs as applied to sternframes of ships, rail special work and locomotive frame repairs.

Lorn Campbell, Jr., welding engineer, United States Welding Co., Minneapolis, read a paper, "Welding And Its Relation To The Repair Industry," on February 4th, before the Society of Automotive Engineers, Minneapolis. The paper is published elsewhere in this issue.

Classified Ads

Help Wanted—50c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—75c per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

Wanted—Salesmen, Demonstrators, Welders and others meeting the welding trade to solicit subscriptions to *The Welding Engineer*, or furnish names of possible readers. When you put your friend or customer in touch with this publication you do him a real favor—make it possible for him to learn more about autogenous welding, liberal proposition. Write me now. Yours for welding, Mackenzie.

For Sale—Slightly used welding and cutting torches and regulators of the following makes:

3—Type "H" Prestolite welding torches with tips, each	$15.00
3—Prestolite acetylene regulators, each	12.00
1—Prestolite oxygen regulator	15.00
1—Davis-Bournonville cutting torch with 4 tips, 1 rivet tip	15.00
1—Davis-Bournonville 17" welding torch with 16 tips	20.00
1—Davis-Bournonville 22" welding torch with 4 tips	20.00
1—Davis-Bournonville oxygen welding regulators, each	20.00
2—Davis-Bournonville Acetylene line regulators, each	20.00
3—Imperial type "B" welding torches with tips, each	15.00
2—Imperial type "E" cutting torches with tips, each	15.00
4—Imperial oxygen regulators, each	10.00
1—Imperial lead burning torch, bench block and oxygen regulator, also acetylene reducing valve	15.00
7—Bird welding torches with tips, each	6.00
1—Harris cutting torch without tips	15.00
1—Economy cutting torch, Style "E," 2 tips	15.00
1—Searchlight cutting torch, 3 tips	15.00
1—Superior welding torch, 1 tip	8.00
1—Superior cutting torch, 3 tips	12.00
1—Economy welding torch, 16 tips and extension	10.00
1—Oxweld oxygen cutting regulator	20.00
1—Oxweld acetylene cutting regulator	15.00

Kentucky Oxygen-Hydrogen Co., Louisville, Ky.

For Sale—1 brand new Henderson-Willis 100 pound generator, $300.00. Kentucky Oxygen-Hydrogen Co., Louisville, Ky.

Wanted—Second-hand acetylene generator. Must be in good condition. State make, capacity and price f. o. b. cars, ready for shipment. Address Western Hog Oiler Co., Washington, Iowa. 1t-Feb.

Wanted—Salesmen, experienced in welding and cutting apparatus and supplies. Experience in hydrogen particularly desired. Well established electrolytic company in the West. Give complete information with references and picture in first letter. The right man can grow with us. Railroad fare refunded to successful applicant. Address FEF, care *The Welding Engineer*. T. F.

Wanted—Demonstrating welder and service man by oxygen manufacturer operating in the east. Must be an experienced, competent man capable of carrying on demonstrations in result getting manner. Furnish full information in your first letter. Address L 27, care of *The Welding Engineer*. 1t-Feb.

For Sale—A Davis-Bournonville Acetylene Generator, slightly used, cheap, for welding purposes. Address F. L. May, 99 John Street, New York, N. Y. 1t-Feb.

Welders—Oxy-acetylene welders who have had experience on steel plate and tank work. Apply with references to Welded Products Co., Birmingham, Ala. 1t-Feb.

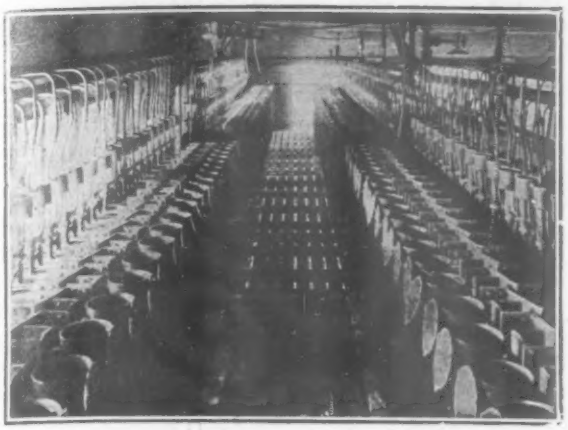
Wanted—To buy an electric welding outfit. City power, A. C. 110 and 220 V., 60 C. Ocala Motor Co., Box 265, Ocala, Fla. 1t-Feb.

Wanted—2nd hand carbide kegs. Size approx. 12½" diam. x 23" high. Must be in good condition with either friction or screw lids. Advise quantity. Address, C. K., care *The Welding Engineer*. 4-t-2-3-4-5

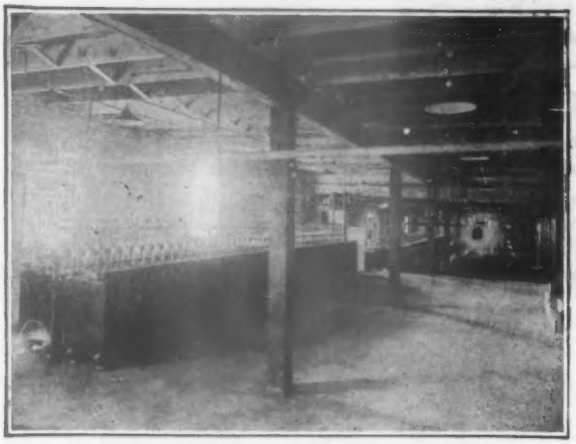
Job Wanted—Acetylene welder of exceptional ability wishes to connect with a reliable firm in need of the service of a man capable of handling such a department. Address 291, care *The Welding Engineer*. 1t-Feb.

Wanted—All around job welder, one who understands metals, expansion and contraction. Good salary to right man. Steady position. Address S., care *The Welding Engineer*. 1t-Feb.

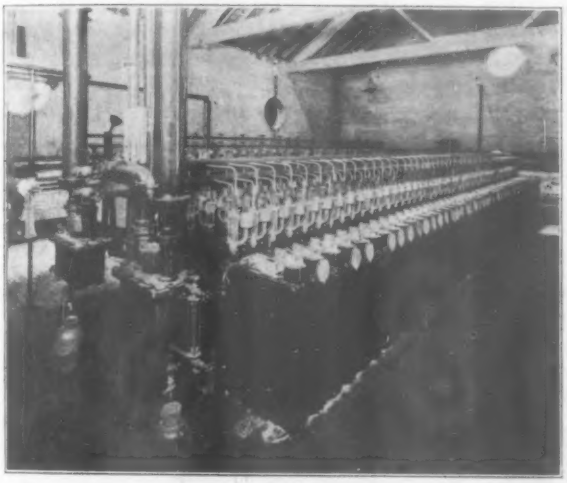
Job Wanted—As foreman or welder. Four years' experience in job shop and production work. Prefer South or Southwest. Address 293, care *The Welding Engineer*. 2t-Feb.



Levin Cells at General Electric Co., Erie, Pa. First installation in foreground, second installation in rear. A Third installation of 100 recently purchased makes a total of 300 Levin Cells.



Bettendorf Oxygen Hydrogen Co., Bettendorf, Iowa, operate 200 Levin Generators.



Cleveland Wire Division of the General Electric Co., Cleveland, Ohio, operate 200 Levin Generators, the second installation consisting of 100 cells.

Second installation consisting of 200 Levin Cells for the Portland Oxygen and Hydrogen Co., Portland, Oregon.

FOUR STRONG RECOMMENDATIONS

The best recommendation in the world is a REPEAT ORDER.

The first installations in the above photographs were batteries of 100 cells. Each of these plants have either doubled or tripled their initial capacities.

We merely give these four illustrations as an expression of confidence that is placed in LEVIN CELLS to meet the tremendous output of these leading concerns. Smaller batteries of LEVIN CELLS have been enlarged, doubled and trebled. Not once has the LEVIN CELLS system been reduced.

We will be pleased to send you recommendations from smaller installations. Write to our engineers and obtain complete technical details. Ask where you can see LEVIN CELLS in operation.

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Live Salesman Wanted

Experienced oxy-acetylene apparatus salesmen are wanted in Pittsburgh, Cleveland, Cincinnati and St. Louis. Only aggressive men who have made good need apply. These men are wanted to introduce and sell one of the finest constructed and efficient torches in the United States. The price is right and to the right men we will make an attractive proposition.

Give full particulars about yourself in first letter. Correspondence confidential. Address 289, care *The Welding Engineer.*

Job Wanted—Married man, 35 years old with 12 years' experience in welding, demonstrating and sales engineer, wants position as sales demonstrator, or can take charge of welding department. Excellent references. Address Resident, 949 Tenth Street, Milwaukee, Wis. olt-Feb.

Job Wanted—Experienced all around welder, would locate in Iowa. Norman Lawson, 300 South Winchester, Chicago, Ill. olt-Feb.

Job Wanted—Experienced electric welder seeks better position. R. H. Allen, Gorver Street, Hammond, Ind. olt-Feb.

Wanted—Full information relating to public and private schools of welding. Address *The Welding Engineer.*

Wanted—An acetylene manufacturing company wants man who has had experience as a welder and cutter to sell acetylene. Location New York City. Experience necessary. Address Acetylene, care *The Welding Engineer.* 1t-Feb.

Wanted—First class all round welder (oxy-acetylene process only). A good position for the right man. Hot air artists not wanted. Address, 894, care of *The Welding Engineer.*

For Sale—One Seam Tubing welding machine 1¼" tubing complete with 5 pointed torch water cooled tip. $780—a snap. Address 893 care *The Welding Engineer.* 1t-2

For Sale: 4½x5 inch three stage Norwalk hydrogen compressor. Used one year. For particulars address 892 care *The Welding Engineer.* 1t-2

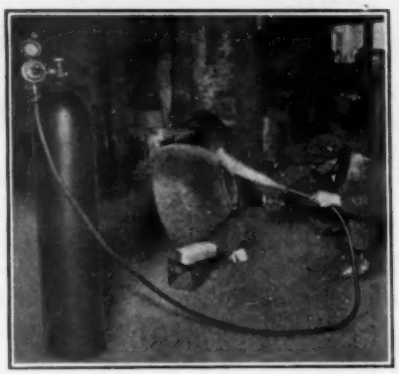
Superior Brazing Compound

A product of years of time and study. Over 98 per cent pure boron. Its use is not attended by deposit or scale. Acts as a superior flux and purifies the brazing spelter, causing spelter to flow evenly into every part of joint, without deposit, scale or enamel. A trial will convince the experienced welder of the merits of Superior Brazing Compound.

If your dealer cannot supply you, we will.

Standard Mfg. Co.
318 S. Canal St., Chicago

Cheaper than any other compressed gas



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Brazing
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Welding
Cast Iron

Rockgas Products Company

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PITTSBURGH, PA.

U.S. *Something New for Welders* **U.S.**

WELDERS MOULDING COMPOUND

Every Oxy-Acetylene and Electric Arc welder has undoubtedly felt the demand for a fire resisting compound which could be moulded into any desired shape. When building up metal around holes in castings, and where welding is necessary thru a machined part, such as a bearing, much time and machining can be saved in addition to making a neater appearing job by employing such a compound. Carbon blocks and rods have their field, but it is very limited. "Welder's Moulding Compound" can not only be used wherever carbon has been, but it has a much wider field. Moulds can be made for any missing lugs or parts and new ones cast that have all the appearance of having been machined. Aluminum parts may be "backed-up" preventing the collapse of the metal when heating.

For aligning broken sections, whether large or small, the usual shimming process may be forgotten and much time saved by using this compound as a cushion for the work. It can be used in hundreds of different ways, over and over again—it don't wear out. The wide awake welder will appreciate its true worth.

5 lb. Boxes with directions for use.....$2.50

Manufactured only by

UNITED STATES WELDING CO., Inc., MINNEAPOLIS, MINN., U. S. A.

Compressed Gas Association Meets

The seventh annual meeting of the Compressed Gas Manufacturers' Association was held at Rumford Hall, Chemists' Club, 50 East Forty-first Street, New York, N. Y., on Monday, January 12, 1920. The morning session was called for 10:00 A. M., at which the president, Dr. Hugo Lisber, made a short address and announced that the second vice-president, Mr. A. Cressy Morrison, would act as chairman of the morning session and Mr. A. R. Brunker, first vice-president, would preside at the afternoon session. At the morning session reports of the officers were read, as well as reports of the Auditing, Finance, Membership and Test and Specification Committees. A spirited discussion followed the report of the Test and Specification Committee.

Colonel B. W. Dunn, chief inspector of the Bureau of Explosives, addressed the meeting and talked regarding the work done during the past year concerning cylinder specifications, etc. He spoke of the help given the bureau by the association, the value of such help and the unselfishness of the members in such work.

At the afternoon session the reports of the Legislation, the Business Methods and the Transportation Committee, were read and discussed and Colonel E. J. W. Ragsdale, formerly of the Ordnance Department, addressed the meeting with an interesting talk on the development of the Chemical Warfare Service. Professor Comfort A. Adams talked to the members on the subject of co-ordination and the results of co-ordination, particularly as applied to research work. Five new members were elected to membership.

At 7 o'clock in the evening the association held its seventh annual dinner at the Manhattan Club, New York City. Covers were laid for 230 representatives of the different companies. The dinner was a most happy affair and the attendance surpassed by 90 the previous record of attendance.

The Compressed Gas Manufacturers' Association now has on its roll 155 members, consisting of 99 compressed gas manufacturers and 56 individuals or concerns directly connected with the compressed gas industries. Approximately 98 per cent of the compressed gas business of the United States and Canada is now represented by the association.

Never use an open light around an acetylene generator. Use only an electric lamp bulb protected with a strong wire guard. It is advisable to use a bulb in which the filament is in vacuum in preference to the new lamps filled with a neutral gas. The reason is that the filament in a vacuum bulb burns out instantly when the air strikes it, whereas in the gas-filled bulb the filament will continue to burn for some time, often giving out puffs of incandescent gas as it slowly burns up. Hence it is much more likely to fire a gas-filled atmosphere than a broken old style carbon filament lamp.—Autogenous Welding.

The Knapp Company, 4th Ave. and 19th St., New York City, have designed some very handsome and interesting calendars, booklets, follow-up letters, advertisements, etc., for the welding trade. This company has recently made some attractive calendars for the Dayton Welding Company, Dayton, Ohio.

L. Lawrence & Co. have moved into new quarters in New York City, and are now located at 355 West Fifty-seventh Street, near Broadway, with a large floor space and better locality. The shops will be located at this address.

The Northwest Auto Show was held in St. Paul, January 31st to February 5th, and not in Minneapolis, as previously stated in *The Welding Engineer*.

It's Made Better

It Works Better

Sure Pressure Acetylene Generator

A reasonably priced and reliable working machine—simple to operate, made of few parts.

Write for Information

SURE PRESSURE ACETYLENE GENERATOR CO.
1010 West Main Street
OKLAHOMA CITY
OKLAHOMA

BLOWPIPE MANIPULATION

A New Method of Executing Welds*

It will generally be admitted that the methods of manipulating the blowpipe and executing welds as described in practically all text books, taught in all welding schools, and carried out in almost every workshop, are in agreement.

The welds are obtained by inclining the head of the blowpipe at an angle between 60 and 90 degrees to the plane of the weld and giving it some form of motion. The motion of the blowpipe is away from the welder and not towards him and the relation of the blowpipe, weld and filling material are as shown in Fig. 1.

—Usual position of blowpipe and welding

Fig. 1. Usual Position of Blowpipe and Welding Rod.

In comparatively light work the blowpipe is held in the direction of the line of welding and a motion is imparted to the blowpipe which will cause the flame to describe a series of overlapping circles, the overlapping extending in the direction of welding, as shown in Fig. 2. In heavier work, if the above method were used, a great deal of the motion would be superfluous, consequently either a zig-rag motion, or one in which the flame will describe semi-circles is used, Fig. 3.

To the average beginner the regular control of these motions is difficult, and considerable practice is required to become skilled. The method of executing welds follow these general principles, but variations are made according to the metal, its thickness, the dimensions of the work, and the skill of the operator. In all cases the welder operates from

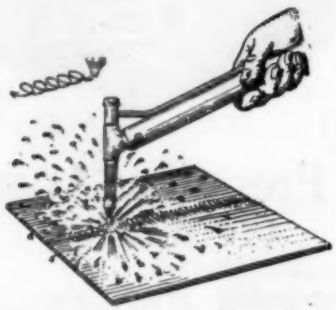

Fig. 2. Manipulation on Thin Material, Old Method.

right to left and inclines the flame in the direction in which the weld is being executed, the welding rod being advanced in the same direction. Variations in these methods are found in certain welding machines, working without a welding rod, and in the special case of welding angles, round material, or shapes which necessitate holding and manipulating the blowpipe in a different manner.

It is only logical in a new industry like oxy-acetylene welding that its methods should be open to variation and its development should be continuous. It follows that there are engineers interested in the process who are not content to accept as final, methods of work which in some cases are the result of laboratory research, and who are endeavoring to improve old methods and disover more efficient methods of executing welds. This is the case for the new method of executing welds now to be described.

In 1916, M. Roulleau, a well-known French acetylene engineer, was sent by his firm to Italy in connection with the manufacture of large welded projectiles. The welds were being made by welders with little knowledge of the process and examination showed that from a defective welds point of view it was difficult to get worse results. The welds were porous, adhesion was common, and the solidity of the joints was extremely bad. The supervision of the 1,000 to 1,200 welders distributed through seven or eight different works was a serious problem. The daily consumption of oxygen and carbide, at a cost of thousands of francs, in producing work of the type described made it an urgent economic problem to bring about improvement. Faced with these various problems, M. Roulleau, after experiment, solved and introduced the methods of work indicated in this article into the various Italian workshops which came under his technical supervision. This change in methods produced excellent results, particulars of which will be given later.

More or less irregularly the process penetrated into France to be applied to the same class of work, welding steel plates about ⅜ inch in thickness, but the method was applied without any definite knowledge with the result that the work was unsatisfactory and the new method did not develop.

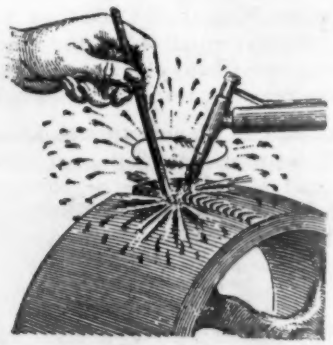

Fig. 3. Manipulation on Thick Material, Old Style.

On returning to France after a mission of three years in Italy, M. Roulleau collaborated with the Union de la Soudure Autogène with a view to a wider application of his methods, to determine accurate methods of executing welds and to control the results obtained.

Title.—We have called the new method of welding "Welding Backwards," or welding from *"left to right"* as there is no other term which expresses in a better way the method. It is called "welding backwards" because the flame is inclined to the direction in which the weld is being produced and "left to right" to indicate the direction of the blowpipe movement. Both cases are opposite to the usual method of procedure.

Definition.—Welding backwards may be defined as the method of executing a weld in which the welding rod follows the blowpipe as opposed to preceding it. Or again, it may be defined as a method in which the flame is inclined towards the welded portion. A fuller and perhaps better definition would be: The flame is inclined backwards and only undergoes a slight transversal motion in addition to its regular advancement, the welding rod follows the flame and is given a movement, the end of the rod always being molten.

*From *Acetylene and Welding Journal,* London, England.

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654 W. Lake St., Chicago
319 Metropolitan Bank Bldg., New Orleans

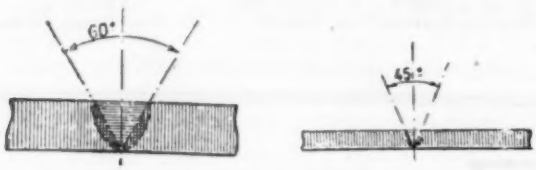
In conclusion it may be stated that welding backwards consists in operating in a manner almost exactly opposite to forward welding, if this latter expression can be used to designate the usual method of executing welds.

Advantages.—Having acquired the method of welding backwards the welder will find it easier to execute welds by this method. The penetration is always satisfactory, adhesion is almost impossible; the metal is sound, there is a diminution in the amount of oxide, and the metal is more ductile. Finally, the speed of welding is very much greater than with the old method from which it will be gathered that there is economy in labor and gases which amounts to at least 25 per cent and sometimes reaches 30 to 35 per cent. The economy in the consumption of filling material is of the same order as it is possible to reduce the beveling angle. To summarize we have better welds, with a guarantee of good execution, and great economy.

Applications.—This new method of welding is applied mainly to steel plate above $\frac{1}{16}$ inch in thickness. It should be used on all plates falling in the range of $\frac{1}{8}$ to $\frac{1}{2}$ inch in thickness.

The process is particularly valuable for certain industries such as the manufacture of boilers, etc.

Its application to mild steel has been specially studied. A certain number of experiments which we have made have shown that welding backwards gives better results than the usual method when welding steels with a higher carbon content—medium and hard. It is not satisfactory for aluminum welding and gives indifferent results when welding cast iron. On the other hand, the first series of tests in using the method when welding copper and brasses have proved satisfactory.



Figs. 4 and 5. Beveling for Thick and Thin Material.

When comparing the new method of executing welds with previous methods, one might say that welding backwards is a "more mechanical" method. From this it follows that more definite rules have to be observed in executing welds and it is advisable, especially for beginners, to strictly observe the rules laid down. These instructions, which are the result of investigation, may subsequently be modified and added to, but in the meantime they give good results and should be followed.

For example, it will be noticed that for this method of welding, the edges of the two pieces of metal to be welded should be chamfered or beveled, so that when they are placed together, the two beveled edges form a V. Although the angles of the bevel can be reduced, beveling is still indispensable, even on thin material.

Preparation of the Metal.—The parts to be welded are prepared in the ordinary way, tacks, or short welds, at intervals of from 2 to 6 inches, according to the thickness of material may be used. In the absence of jigs, the parts are supported so that the lower edges are in the same horizontal plane. The angle of the V formed by the two beveled plates should never exceed 90 degrees, and, as already mentioned, for this method can be distinctly less. Beginners can gradually reduce the angle of the V from the previous standard of 90 degrees until they arrive at 60 degrees for material $\frac{1}{4}$ inch in thickness or above, and for material between $\frac{1}{8}$ inch and $\frac{1}{4}$ inch an angle of between 45 and 50 degrees can be used. (Figs. 4 and 5.)

The beveling should be carefully done and extend the full depth of the plates as partial beveling will produce defective welds.

Power of Blowpipe.—The power of a blowpipe, in other words, the quantity of heat which it is capable of giving out in a given time, is universally measured by the number of litres (or cubic feet) of acetylene burnt in an hour with the flame perfectly regulated. The general rule which has been adopted for welding steel by the usual methods of executing welds can be followed for the new method, namely, that the consumption should be about 5 cubic feet of acetylene per hour for every $\frac{1}{16}$ inch in thickness. So that for material $\frac{1}{16}$ inch thick, a blowpipe consuming about 15 cubic feet per hour would be required, for $\frac{3}{8}$ inch one consuming 30 cubic feet, and so on. However, it will be found that beginners obtain the best results by using less powerful blowpipes than those indicated, whilst the more expert welder rapidly reaches the stage where he can advantageously use a more powerful blowpipe, as for example, for $\frac{1}{8}$-inch material, a blowpipe consuming 375 litres (5.3 cubic feet); for $\frac{1}{4}$-inch material one consuming 570 litres (20 cubic feet); and for $\frac{3}{8}$-inch 1,140 litres (40 cubic feet).

Welding Rod.—The choice of the right size of welding rod or wire is of great importance. A wire that is too small melts too freely, has a tendency to burn, and is distributed badly. The defects of adhesion and oxide inclusions are common. If the wire is too large, the rate of welding is retarded, the molten bath is cooled, and it is difficult to add the metal uniformly. In both cases burning and overheating of the welding rod and material are likely to take place.

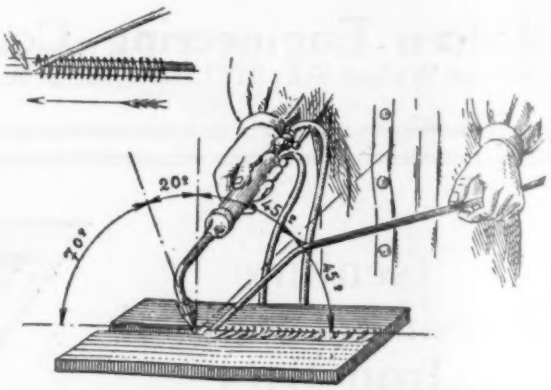


Fig. 6. Position of Blowpipe and Welding Wire.

The following table gives the sizes of wire for welding various thicknesses. It will be noticed that they are slightly less than the values previously given for the ordinary method of executing welds.

Thickness to be Welded In Inches	Diameter of Wire S. W. G.	Diameter of Wire Decimal Equivalent	Diameter of Wire Nearest $\frac{1}{64}$
$\frac{1}{8}$	14	0.081	5
$\frac{5}{32}$ to $\frac{7}{16}$	11	0.116	8
$\frac{1}{4}$ to $\frac{5}{32}$	8	0.160	10
$\frac{11}{32}$ to $\frac{13}{32}$	6	0.192	12
above	4	0.232	15

Position of Blowpipe.—The flame of the blowpipe should be given a definite inclination. In certain cases and especially with expert welders, familiar with the new method of executing welds, this inclination of the flame to the plane of the weld is very small, in other words, the flame is almost perpendicular to the weld. We have, however, made a series of experiments to discover the best angles and have found that an angle of 20 degrees gives the results, that is to say, the angles between the nozzle of the blowpipe and the perpendicular should be 20 degrees, the flame being turned back-

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wards as shown in Fig. 6. Beginners should pay particular attention to obtaining and practically working at this angle of inclination.

D. R.

WELDING SCHOOLS

The International Acetylene Association desires to complete its record of welding schools, and readers are urged to furnish *The Welding Engineer* the following information:

Name of School
Address
Name of Instructor
Length of Course
Day Course
Night Course
Fee Charged for Day Course
Fee Charged for Night Course
Days on which Lessons are Held
Nights on which Lessons are Held
Number of Hours Devoted to Actual Welding
Remarks.

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EXPANSION AND CONTRACTION

A small boy asked by his teacher to give an example of the effect of heat and cold, replied that the days were longer in summer and shorter in winter!—Autogenous Welding.

Franklin or (white metal) can be easily welded with aluminum solder. Use a small tip with a slightly reducing flame (excess of acetylene) and use the aluminum solder as a filling rod.

The Columbia Mfg. Co., Belleville, Illinois has issued Grinder Book, No. 26, covering grinders and buffers, countershafts and presses for the welding, heavy hardware, mill supply and auto trade.

When preparing heavy castings for welding with a pneumatic hammer some welders advise using a round nose gouge instead of a flat chisel. Driving the gouge lengthwise in the seam will result in a channel having a rounded bottom and approximately vertical sides, provided the metal is thick. The claim is made that a better weld can be made in the rounded bottom groove in heavy cast iron welding than in the conventional vee groove.—Autogenous Welding.

The Torchweld Equipment Co., Chicago, have issued a new booklet relating to the difficulties encountered by the welder. It is in the nature of an instruction book. It will be sent free upon request.

BOUND VOLUMES

A very small number of Bound Volumes of The Welding Engineer for 1919 are in hand. Price $6.00.

EFFECT OF HYDROGEN ON IRON AND STEEL.

German technologists have continued their researches since the armistice, one of these being the effect of various gases on iron and steel. The results suggest, says its London Ironmonger, that if the gases could be conveniently and safely applied, some of them and particularly hydrogen might be employed with advantage in certain metallurgical operations, as in the cementation process of making steel and in refining and hardening. The use of hydrogen with iron at high temperatures, however, unfortunately is difficult and dangerous, apart altogether from its high cost, and it is not likely therefore that it will be used for any of these purposes on any commercial scale, though it may continue to be used for research. When that gas is forced through molten iron it is found that any non-metals present such as arsenic, carbon, phosphorous, silicon, sulphur or oxygen are converted into gaseous hydrides while the hydride itself in any particular case may be split up again and the nascent hydrogen set free, under which conditions it will reduce any silica present in the metal, even at so low a temperature as 1292 deg. Fahr., the gaseous silicon hydride resulting.

From the practical point of view the most interesting of the results of this particular research lies in the revelation that a malleable iron may be made directly, by means of oxygen and hydrogen not only from molten iron but from solid pig. The inert character of nitrogen is confirmed by this research, that gas having no effect on the non-metals in iron, either in the solid or liquid state, notwithstanding the view very generally held that the carbon in iron will diminish if the metal be heated in an atmosphere of nitrogen, the real explanation of this diminution being the action of small portions of oxygen retained in the vessel with the nitrogen.

In order to obtain closer co-operation between the factory and the sales department, the Electrolabs Company announce the consolidation of their offices at 2635 Penn Avenue, Pittsburgh, Pa. Correspondence should be addressed in the future to this office. For the convenience of their friends and customers, a branch office will be maintained at R. 313, 30 Church Street, New York City.

The Electrolabs Company have just issued a new catalogue which will be mailed upon request.

TRIALS OF THE WELDER.

Good morning, Jake, we now start on another week.
Bring over that housing; we will start kind of meek.
I had a tough time Saturday; I feel kinda weak.

I bet when the old guy that owns this car
Learns what we will soak him he sure will get a jar.
Come on with that flux, you Rummie; don't you know
This stuff without it will never flow.

Here comes a gink—well, I'll be damned;
He has got an old broken sink.
This shop is the limit for broken and jammed,
If we don't get the worst ones I'll be hanged.

Bring over some charcoal and put in that casting.
By the looks of that crack, for our lunch we will go fasting.
Take a slant at your gas, this job we will finish,
And if it goes wrong your pay will diminish.

Now there goes the tip; you must be a bird to keep this torch lit.
Now take it from me the way we have been working,
It's plain to be seen the work we are not shirking.
By the way it's been coming there's enough here for three;
We must get another welder, you can take it from me.

That last one we had, I guess he was bad,
On that aluminum case with a number 12 tip that was sad.
This new one's been at it since '94.
Believe me kid we will learn some more,
When he comes in give him that small one,
That two toner near the door.
Let's work on that joy wagon that bumped into a tree,
The guy that drove that one was sure on a spree.
My jeans full of kale and a boat like that, holy gee,
What more happiness do you think there could be?

Turn off those old gas tanks, we will quit for the day.
Believe me, young fellow, a welder sure earns all his pay.

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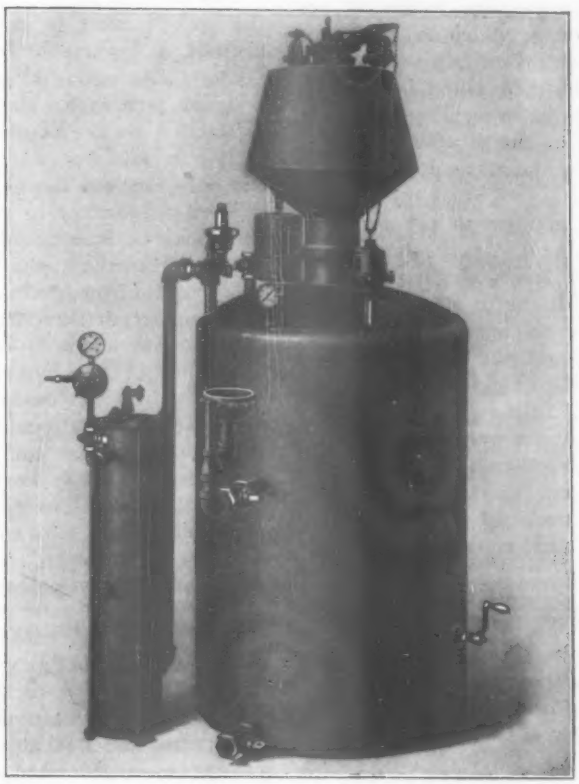

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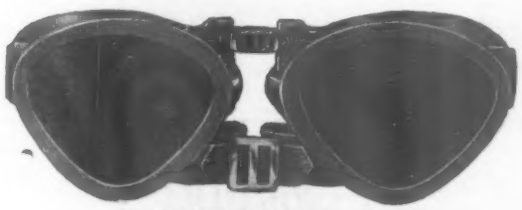

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SHORT HOURS AND HIGH PRODUCTION.

We have heard much in the past few years about the decrease in production which has accompanied the successive increases in wages and the progressive shortening of hours. But we have heard of few instances where the employers have taken their men into their confidence and explained to them exactly what shorter hours and higher wages meant to both employer and worker. In two instances recently brought to our attention such explanations were made with gratifying results.

The cases are quite similar. The shops in question are large, one employing a few less than 1,000 men, the other somewhat more than 1,000. Both are in the metal working industry. Both are open shops, but in one nearly 90 per cent of the men belong to the union, which in the other less than 10 per cent are union men. Both shops operated 55 hours per week. In one case the men asked for the 44-hour week, together with a substantial wage increase. In the other case the directors decided on the shorter week with a corresponding increase in wages, without any request from the men.

In both case the men were called together in a mass meeting and the situation explained to them. In substance they were told that the change in hours and wages represented on its face an increase in the cost of the product, exclusive of material, of about 30 per cent; that the business was highly competitive, and that the product could not long stand a 30 per cent increase in cost, as a corresponding advance in selling price would mean loss of orders. In time the plant might be compelled to suspend operations, cut wages or lengthen the hours. The only alternative was that the men so perform their part as to produce as much finished work in the shorter week as they previously produced in the 55-hour week. If they did this the arrangement could be made permanent.

At the end of three months the general manager of the larger plant, when questioned as to the result of the experiment, said: "The men came through in splendid shape. I am entirely safe in saying that they are now doing as much in the eight hours as they formerly did in ten, if not more. In the other case definite figures are available. The producer-hours per unit of product since the shorter week took effect have decreased 26 per cent and are still going down."

It is proper to add that neither company put upon the men alone the solution of the problem of increased productiveness. The managers took it upon themselves to assist by every means possible to diminish wasted effort and eliminate idle time of both men and machines. The men, however, understood their purpose and co-operated rather than opposed their efforts, as is too often the case.

Misunderstandings are too frequently at the bottom of labor troubles. The moral of the above incidents is obvious for those who care to heed it.

Iron Age.

MANGANESE STEEL

The welding of manganese steel is a problem which is usually found in the Frog Shop on railroads, although dredge dippers, safes and other machine parts are manufactured from this metal. Some authorities claim that it is possible to weld manganese steel successfully, but in the author's opinion the process is not yet a complete success, by the oxy-acetylene process.

Manganese frogs and crossings contain between 11% and 13% maganese, and the nature of the problem will be better understood when it is explained that when the manganese content is increased above 2% or 3% the strength and ductility decreases, while the hardness increases.

Manganese frogs and crossings frequently require building up at low points. These low spots are usually caused by the metal becoming fatigued and sagging from the constant pounding of rolling equipment. When made frogs or crossings occasionally contain blow holes, or pockets, not visable to the eye. These pockets are generally just below the low point and extend the full length of the section which requires building up. Frogs and crossings containing such defects are not susceptible to a welding process. Should the section require the building up of a worn spot, caused only by constant pounding, it may be treated autogenously.

The frog or crossing should be preheated to about 1230 F. (Medium Cherry) and after the worn spots are built up, during which process the frog or crossing is kept at the aforementioned temperature, it is allowed to cool very slowly. This can be accomplished by burying the object in dry sand.

The parts to be built up should, prior to starting the building up operation, be thoroughly cleaned. Either files, wire brushes, or a portable grinder may be used for this purpose.

The low sections should be built up in sections of about 1 square inch each. Care should be taken to raise the built-up section to the proper height. While the metal of each section is still hot the section should be hammered. This not only expands the new metal, but also serves to impart a finished appearance to the weld. The proper surface alignment may be maintained by the use of a straight edge.

Another method which has been used with success is to immerse the frog or crossing in a pan of sufficient depth and width to permit surrounding the entire object with water, a space of but about ¾ of an inch below the surface of the rail showing. This pan may be so constructed that a constant flow of cold water passes through it. When this method is used no after treatment is necessary.

The correct filler rod to use for this work is manganese, and these rods may be made by cutting up old manganese rails. Manganese welding rods are now manufactured for the welding trade. As manganese possesses a marked affinity for oxygen, however, and will burn out very rapidly under the influence of the torch, the necessary rods should not be cut out from old rails with the cutting torch. Some other method should be used, or preferably, new rods procured. The process of building up the worn section will in itself burn out manganese from both the original rail section to as near a 11-13 per cent content as possible, it is advisable not to multiply the difficulties by an advance reduction of the manganese content in the filler rod.

The author has heard welders complain that under the action of the torch, manganese steel would "foam," making it exceedingly difficult of execute welds. As a proposed remedy for this difficulty it has been proposed that a very fine aluminum wire be wound around the manganese welding rod in the form of long spirals. The introduction of a very small quantity of aluminum into the weld is said to "quiet" the metal. So-called foaming, however, is an indication that the manganese content has been reduced to a very small percentage.

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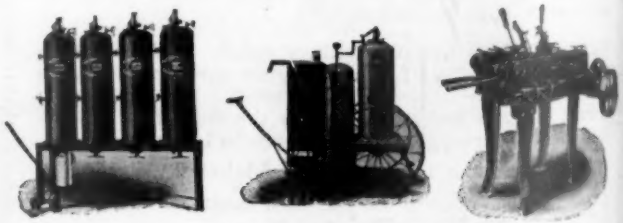

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